Journal of the Society of Arts.

FRIDAY, APRIL 24, 1868.

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday evenings, at Eight o'Clock :—

APRIL 29.—"On Progress in Oyster Culture." By HARRY LOBB, Esq.

MAY 13.—"On the various Methods of Lighting Streets by Gas, with Proposals for the introduction of an Improved System." By S. TUCKER, Esq.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal at their first meeting in May next. This medal was instituted to reward "distinguished merit in Promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to His Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. W. Fothergill Cooke and Professor Charles Wheatstone, F.R.S., in recognition of their joint labours in establishing the first Electric Telegraph.

The Council invite Members of the Society to forward to the Secretary, before the 15th April, the names of such men of high distinction as they may think worthy of this honour.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement :—

Denton and Haughton Mechanics' Institution.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

NINETEENTH ORDINARY MEETING.

Wednesday, April 22nd, 1868 ; J. CHALMERS MORTON, Esq., in the chair.

The following candidates were proposed for election as members of the Society :—

Powell, Evan, St. Mary's-villa, Newtown, Montgomeryshire.
Welshman, Richard Nash, Dean-street, Soho, W.
Wilson, John, 159, New Bond-street, W.

The following candidates were balloted for, and duly elected members of the Society :—

Barry, J. J. Redmond, Ireland.
Cleghorn, J. The Mount, York.
Fraser, Alexander Colvin, Colchester.
Mitchell, Albert, Elmstead, near Chiselhurst.

The Paper read was—

ON THE CULTIVATION OF BEETROOT, AND ITS MANUFACTURE INTO SUGAR.

BY W. A. GIBBS, ESQ.

It was with great pleasure that I accepted the suggestion of your excellent secretary to bring this subject to your notice, because it is one upon which a learned and influential society like yours can most powerfully and beneficially guide public opinion and direct private judgment. I trust that I shall be able to show both that it is a subject sufficiently large to merit some notice at your hands, and also that there is just now a very urgent need for a thorough and searching discussion of its possibilities; inasmuch as the time has evidently arrived for a renewal of enthusiastic but somewhat desultory efforts to establish this special manufacture in these islands. One gentleman who has been successfully engaged for many years in the refining of sugars, and who has of late been importing from the Continent raw beetroot sugar to the extent of 300 tons per week, has already commenced an establishment at Lavenham, in Suffolk, and made some preliminary arrangements with the farmers for a supply of roots. Others are reported to have pledged themselves to follow in the same track, and this in the face of some five or six former failures. One cannot but admire the indomitable English perseverance that, in the fights of industry, as well as on the field of battle, ignores defeat, and refuses to accept any failure as final; but one knows that if this courage were less rash and hasty it would achieve still greater results, and suffer fewer disasters.

A few statistics of the steady and enormous growth of this industry abroad, will, perhaps, show a good and sufficient reason why British enterprise returns again and again to the attempt to vie with the Continent in so large and important a manufacture. The number of factories abroad, in 1839, was about 270; in 1848, about 1,200 or 1,300; and at the present time about 3,200. Thus, in thirty years, the Continent has increased its possibilities of production more than tenfold, and now contributes about 670,000 tons of sugar per annum to the world's stores. This is nearly one-third more than we import from our colonies into the United Kingdom, and represents an annual value of nearly twenty millions sterling. Coincident with this growing production abroad was a somewhat noteworthy change in our imports at home; in 1843 we derived nearly the whole of our supply from our own possessions, 4,000,000

cwts. being imported from the colonies as contrasted with 70 cwts. or 80 cwts. from the Continent; but by 1859, our consumption having regularly but rapidly risen to a total of 9,000,000, 5½ millions of that supply was obtained from the colonies direct, and 3½ millions from the Continent. Whether any notable quantity of these 3½ millions was absolutely beet-sugar or merely colonial sugar for which there no longer existed a demand on the Continent, and which was therefore passed on to us, the effect appears to have been the same, for by 1859, their manufactories had attained colossal proportions, both as to number and extent. One factory alone, at that time covered twelve acres of land with its buildings, besides having fourteen subsidiary kilns placed at intervals within a circle of seven leagues around the central establishment, 670 tons of sugar per week being the average product, and 300 head of cattle being fattened on the beet pulp after the extraction of the sugar. In another establishment a capital of eight million francs was embarked, and 3,000 people employed; and it had become quite a customary thing for even princes and noblemen to erect factories and distilleries on their estates. Up to this time nearly all the sugar thus imported into England was in the raw state, and required to be prepared for English palates in English refineries. Hence arose in London, Liverpool, Glasgow, and other of our great cities, a number of extensive and costly refineries, wherein every appliance of scientific discovery and mechanical skill was adopted and perfected to the end in view. Steam engines of large power, air pumps, vacuum pans, hydraulic presses, centrifugal machines, steam hoists—all the powers of art and nature seemed to be impressed into the service; and that *primum mobile*, gold, being also lavishly expended in rendering perfection more perfect, a large body of skilled artisans and well-paid labourers found ample employment in this industry and its correlative branches. But whilst capital and labour were thus building up a prosperous manufacture here, the same two agents were at work on the Continent also; and, not content with supplying us with the raw material, and competing with our colonies only, the foreigner gradually added refineries to his factories, and having that raw material direct from mother Earth, without any intermediate profit to pay for, undersold us in our own markets. This he was the better able to do, inasmuch as our legislative experiment of equalisation of the duties enabled him to send us the refined and manufactured qualities at a very slightly higher duty than the raw. As a consequence of this and other causes many of the capitalists who had embarked their property in this special trade were obliged to close their works, and large numbers of workpeople have been turned adrift to swell the tide of pauperism at the east end of London. Within the last three weeks some of the largest and best-appointed refineries in London, costing for their erection and internal fittings little less than £50,000, have been put up to auction, pulled to pieces (although in first-rate working order), and their contents sold for the price of old metal. During the past year eight others shared the same fate, and many others will shortly follow. It is not, therefore, to be wondered at that energetic, forecasting men should be again bestirring themselves to bring to issue the question whether England, Ireland, Scotland, or Wales cannot compete with France, Germany, and Holland in the growth of a produce which would help to support the existence of their trade. At this point, therefore, I would again revert to the valuable aid and encouragement a scientific body such as your Society of Arts can give to this revived experiment—First, by organising systematic wide-spread trials of experimental culture of this root in various districts, with a view to determine whether any soils and climates in these islands are more favourable to its production than others. Secondly, by suggesting careful analyses of the roots so grown, to ascertain their percentages of sugar as compared with those grown abroad; and, thirdly, by stimulating and rewarding agricultural skill and manufacturing ingenuity, in the production of the largest amount of sugar from the plant, and the utilization of its other valuable constituents. The two first of these points, viz., the best locality for the culture, and the obtainable per centages of sugar, seem to call for the more notice, inasmuch as very little, and very uncertain information at present exists upon them. Startling differences of opinion have been uttered in the public papers upon the subject; some asserting that sunshine and light were all essential; others flatly contradicting these assertions, and declaring sunshine and light to be wholly inimical to the end in view. Some tell us that the root will grow in poor boggy soils and damp climates, and instance North Germany as a corroboration; others insist that it must have a rich deep soil, and that marshland and moistures are fatal. Some dogmatically assert that the per centages of sugar in home-grown roots must ever remain too small to pay for extraction, whilst their opponents enthusiastically confute them with the results of some few isolated growths and analyses. Now there is very little real practical experience at present to fall back upon in this country, because the British farmer has always looked upon the beet root as a mere garden plant, mangold wurzel finding much more favour in his sight for stall feeding, and especially for selling purposes, on account of its bigger bulk and weight; but there are a few starting points in this matter that it may be as well to summarise. 1st. The root being long and taper by nature, a deep, and somewhat loose and light staple will afford it the best chance of "form" development. 2nd. Solid constituents, rather than watery bulk, being the measure of its value, a well-drained subsoil, and a frugal amount of forcing manures will best produce that value. 3rd. As per centage of sugar is in the inverse ratio to the size of the root, such species of seed, and such mode of culture as will result in the smallest rather than the largest roots, will best obtain the desired product; this fact is so important that it will be well to note the difference obtained by careful analysis; it was to the extent of 13 per cent. of sugar in roots of ½ lb. each, as contrasted with 6 per cent. in roots of 4 lbs. and upwards. There is another very important consideration attaching to this culture of small rather than large roots; that is, the lesser weight per acre requiring cartage from the field to the factory. Hitherto, the Silesian white beet seems to be the species most in favour on the Continent, and by general consent is now recommended for adoption here. It can be conveniently taken as one of the crops of the four-course system of husbandry, *ex gr.*, — wheat, with manure; beetroot; clover; oats; but to obtain the best result, it is recommended to sow the seeds in a sheltered place, about the end of February or beginning of March, and to transplant to the fields in May. The after-culture consists in hoeing and weeding exclusively, and hence it is a crop that enables a farmer to clean his land very thoroughly. The quality of seed being of paramount importance, and even the best species having a tendency to degenerate, it would be well to direct the attention of skilful cultivators to the experimental trials of other species of seed, with a view to obtain still higher per-centages of sugar from the root. I have been favoured by the Secretary of the Royal Agricultural Society with five choice specimens of foreign seeds, which I have had sown, for comparison with the Silesian, and I shall hope next season to be able to report the results obtained; but to give any extended value to such results, similar experiments ought to be carried out in many different kinds of soils, and in various districts of the kingdom, and a comparative analysis made of the varieties thus produced. It is by no means improbable that in this way a species of root might be discovered, containing a much higher percentage of sugar than that hitherto obtained; indeed, credible analyses from various authorities

have shown 10, 12, and even 15 per cent. as the contents of certain roots under favourable conditions. Mr. Arnold Baruchson, of Magdeburg and Douai, gives 12 per cent. as the average for Germany; Sir Robert Kane found 14 per cent. in some roots grown in the Botanic Garden, Dublin; Johnston asserts positively that 18 per cent. was found in some beet grown in North Germany; and Vilmorin and Knauer both speak confidently of 18 to 20 per cent being obtainable. If this result should be ultimately realised, beetroot would be able to compete most successfully with the sugar-cane, seeing that that only contains an average of 18 per cent. But setting aside for the present these future possibilities, it is to be noted that the French and German beet sugar makers, obtaining (as they did) only 5 to 6 per cent. from the roots, have been able to develop this manufacture into a large and profitable trade. It would seem, therefore, a fair inference that if our farmers can produce a root containing even this low percentage, our manufacturers ought to be able to deal with it advantageously. But here it will be urged that former and frequent experience disproves the soundness of that inference. Let us, therefore, take a short summary of the former failures, and trace out as closely as possible the reasons why they were failures. By far the greater number of these attempts were undertaken without any requisite knowledge of the details of growth or manufacture, and with a totally inadequate capital. In the first adventure that has been recently described by some of those concerned in it, the land was unsuitable, the supply of roots uncertain and fluctuating, the percentage of sugar obtained absurdly small and so badly manufactured as to be bitter and unsaleable. Other shortcomings and blunders were also described, but I do not think it was needful to particularise more than those just named to account for the inevitably disastrous winding up of that (very) "limited" company. The next failure was graphically described at some considerable length by Mr. Sproule, of Dublin. Briefly, it was a company started in a hurry, in the spring of 1851, and expecting the farmers to have Silesian roots grown ready for them by the autumn of that same year; the farmers, having probably sown their fields before the contracts were offered, did not respond; but some gentlemen at Mountmellick offered to grow some hundreds of tons each; the public, however, did not take up the shares, so an old brewery was turned into a sort of sugar factory, and proved utterly unsuited to the purpose; some machinery was tardily supplied, but no one knew how to fit it, so that when the roots were ready the factory was not; the farmers grumbled, and the season was nearly past before work commenced; at this stage (that is, just when work had commenced) the practical manager was replaced by a gentleman of high theoretic attainments; these failing, a young man from the continent was imported to assist. Fresh contracts were made with the farmers for the following year, and during the summer the old buildings were demolished, and, at heavy cost, new ones were "being erected" when the roots were again ready. Thus ended season the second and last, for the money was spent, the farmers disgusted, and the whole affair speedily found its way into the Irish Court of Chancery. It cannot for one moment be maintained that the disastrous ending of such a disgraceful muddle as this is any evidence whatever, either for or against this manufacture. If men who know little or nothing of a certain branch of trade intrust the management of it to others who know less, I should think that even Zadkiel could predict the result without the aid of the stars. If the mischief ended in the disaster of those who, without sufficient knowledge, undertake small ventures of this kind, it would be bad enough, but these bold espousals and timid abandonments of any cause bring upon the cause itself undeserved and unreasoning discredit, and by confirming prejudice in its instinctive dislike to novelty, retard progress and dishearten enterprise.

In commendable contrast to this absurdly misconducted affair, is one that has not been made public, but the history of which has been described to me, by one of the promoters, so clearly and succinctly that, although I am not at liberty to mention his name, I shall take leave to repeat it in his own words:—

"The experiment of manufacturing beet-root sugar, referred to in yours of yesterday, was made about thirty years ago by a kind of 'company limited,' with a view of proving if it could be done with the root as grown in England, so as to compete in the English market with the then slave-grown sugar of the West Indies and other parts of the world. The capital subscribed was about £2,000. The best method of manufacturing then known in France was adopted. Two Frenchmen, recommended by manufacturers in the north of France, were brought over to instruct and superintend those employed. The machinery—viz., the rasp, hydraulic press, and steam-evaporating pans, &c., were obtained from an engineer who thoroughly understood the whole subject, and I believe the thing had a very fair trial, and some as good sugar was made as the average of the French factories at that time produced. Nevertheless, it was found we could not produce it so as to compete with imported sugar, even though prices were then perhaps on an average 15s. per cwt. higher than at present. The duty on colonial and foreign sugar was much higher than now, and there was every probability that the then Government would be compelled to put a duty on native sugar if its manufacture was extended, and as none of the 'company' inclined to take this and other risks on themselves by continuing it on (it might be) an extensive scale, it was 'wound-up' at very considerable loss. I will just add from recollection two of our difficulties—First, That of getting from the farmers a sufficient supply of roots within a reasonable distance of the factory (we found them the seed—white-beet, imported from France) although we gave from 15s. to 20s. per ton delivered; 2nd, We found, then, the pulp from the rasp of no value—could not even give it away."

In answer to further inquiries, he explained that 3 per cent. was about the average yield of sugar obtained, and that no duty was charged upon what they made.* Now in this case many elements of success seemed to exist; but the poor yield of sugar, the fluctuating supply of roots, the non-utilisation of the residuary pulp, and other valuable constituents of the root, and, finally, the small amount of capital employed, and an apparent want of boldness, combined to defeat what might by perseverance and skill have been developed into a most valuable enterprise. In all these small tentative trials several of the necessary conditions for success were totally wanting. Farming and stock feeding were never systematically combined with the manufacture as they are abroad; and it will be easy to see that without some degree of independance as to the supply of the raw material, and without some compensation in the shape of beef or mutton for the sugar and other feeding properties still remaining in the roots, the work could scarcely be carried on with regularity or without loss; when the farm is conjoined with the factory, such parts of the roots as by want of skill or from inevitable cause are lost to the latter, re-appear in the former in the shape of meat, and this to a considerable extent forms a compensation for the first early blunders. Another point of manufacture, which has never received attention in any former attempts, is the extraction and utilisation of the valuable salts of potash and soda that exist in beet root. Analyses show that an average crop of 20 tons per acre would contain 100lbs. of potash and 60lbs. of soda; the former of these alkalis, when recovered and converted into the mercantile form of carbonate, would represent nearly 1½ cwt. of what is commonly known by the

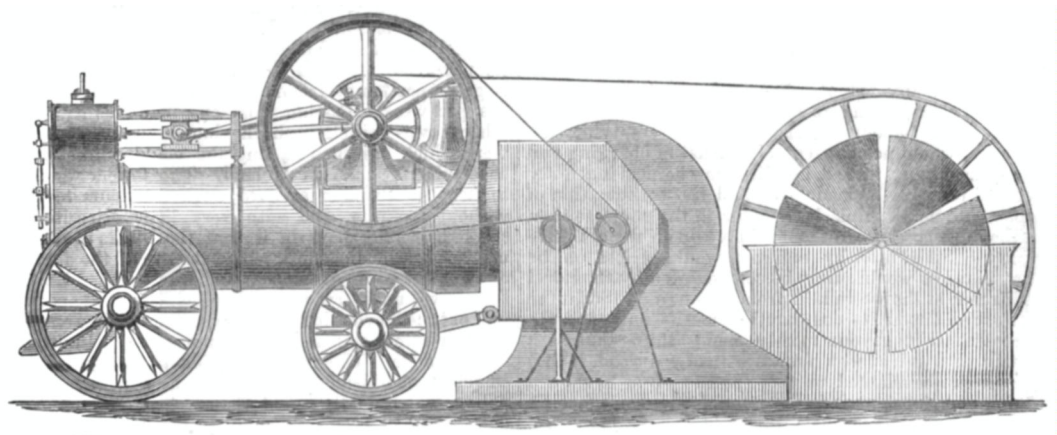
* At or about this date, Dr. Ure, without any "rasps," "hydraulic presses," or "vacuum pans," obtained 5 per cent. of sugar from some white beet grown at Mitcham in Surrey.

commercial name of pearlash, a product which has an average value of between 30s. and 40s. per cwt. This may seem a small matter, but if we estimate the value of the pearlash only, and even deduct one-third of that for possible waste, this alone would give an additional value to the crop of 30s. to 40s. per acre. I can speak confidently as to this product being saved and utilised abroad, because I have of late purchased several tons of it derived from this source. I hope to be able to prove, further on in this paper, that the residuary pulp and the leaves may be rendered much more valuable than they have hitherto been; but before passing from the subject of the comparison of foreign processes with English attempts, I would remark that there are three distinct modes of dealing with this manufacture abroad, and only one of these has as yet been tried here. The first is, rasping the fresh roots, pressing out the juice and treating it in the same way as the juice of the sugar cane, and this is the only method that has been imitated—and very badly imitated—in this country; but there are two other modes in practice—the one finds most favour in France, and the other is very generally practised in Germany. The French plan is to slice the roots thinly, and then steep them in hot water, passing the liquor thus obtained over continually fresh quantities of the sliced roots until the syrupy extract is sufficiently strong for final evaporation and crystallisation. One great disadvantage of both the rasping and steeping is that the extraction can only be carried on during five or six months of the year—say, from mid-October to the end of March, because after this latter date the roots rapidly deteriorate. This circumstance leaves a large portion of the machinery and plant idle and useless for the remaining six months of the year, and involves the necessity of discharging the greater number of the workpeople at the end of each season, and collecting others again in the following autumn. It is true that arrangements for obtaining large bodies of men for temporary and fluctuating work are quite possible, as, for example, in harvesting, draining, and other rough labour; but still, in a manufacture requiring some amount of practical skill, it cannot but be a disadvantage, especially at the outset of a new undertaking where the men lack training to their work. Besides which, if we take a *pro formâ* sum of £10,000 or £20,000 as capital sunk in the erection and fitting up of a factory, the whole interest for the year of the money thus invested has to be borne by the working six months. It would seem, therefore, that if some means of dealing with this manufacture can be adopted, by which the work may be carried on regularly through the whole year without let or hindrance, such a mode of operation would have much to recommend it.

Accordingly, we find that in Germany an elaborate system has been in practical operation for many years, whereby the roots are dried in kilns and preserved for use all the year round. In one large establishment — that of Scheutzenburg's, in Gallicia—fourteen such kilns, costing £500 or £600 each, have been erected within a circle of seven leagues around the central factory, the object of this distribution over so large an area being to reduce the heavy cost of cartage, which upon a root containing fully eight-tenths of its weight of water is very considerable. If, after a searching investigation into the respective merits of these three modes of dealing with the root, it were determined to try this last named one of drying, I would suggest that there seem to be three modes in which this arrangement might be carried out. First, by establishing on a grand scale, and upon the exact system of the continental houses, a vast central establishment and its ring of fixed kilns, taking in an area of some hundred square miles, and absorbing all the roots that could be grown in that area; undertaking also extensive farming operations to consume the residue of the roots profitably. This, if well managed in all its several departments and supported by ample capital, would, in all probability, gain an ultimate and large prosperity; but I do not think public opinion or private enthusiasm is prepared to take so heavy a risk until to some extent assured that soil, climate, and customs of any special district are favourable to the project. A second mode would be to erect a more modest central factory, and to employ, in lieu of the fixed kilns, travelling engines with drying cylinders and hot blast, to deal with the roots on the fields, and draw them in, thus lightened of their excessive water, to undergo the final processes of extraction, evaporation, and crystallisation, returning the pulp to the farmers at an agreed valuation. If this plan were adopted, it might be found convenient to draw in such crops of roots as lay near to the factory, without the previous drying, and extract the sugar from them by either the pulping or the macerating process, whilst the more distant crops were being dried, brought in, and stored, to be worked up during the (otherwise) idle months of the year. My own impression is, that this would be by far the soundest and safest mode of action; but there is yet a third manner which might also have some advantages. A great many farmers throughout England now possess either fixed or portable engines, and every year adds to that number. What is to hinder them from turning these engines to good use for some additional months of the year, by applying them to the drying of any crops of beet-root that they may choose to grow; and thus either sell such dried roots, at a remunerative price, to the sugar factories, or, if failing to obtain a satisfactory price, retain them as a most valuable and concentrated food for stock? Such a method of dealing with this manufacture, in its first stage, would have the following important advantages:—1st. It would dispense with the necessity of risking upon the experiment, heavy and irretrievable sums for new buildings, costly plant and elaborate machinery. 2nd. It would be a very easy and accurate mode of ascertaining if any special district possessed advantages for the growth of this sugar-producing beet, and hence would be the best preliminary step towards the ultimate localisation of this manufacture on a large scale. 3rd. It would, if portable engines were employed, enable the farmer to dry off his roots on the field in which they were grown, and to reduce his cartage home from 100 tons to 20. 4th. It would further enable him to dry the leaves both of beet-root and mangold into valuable and storeable forage. 5th. It would give additional and profitable use to his engine, and furnish him with an apparatus, which, with some slight additions, would enable him to dry his hay or wheat in wet seasons. For farms not yet possessing engines, there is ever ready the hiring system, which could be adapted for root drying just as well as for wheat threshing. Those who lend these engines would be often glad to get additional work for them in this or any other way.

Having thus, as I hope, indicated that such a system would work in practically and easily with our existing agricultural customs, I will now proceed to describe as briefly as possible what, for want of a better name, I will call a "portable kiln," and also some of the experiments that seem to demonstrate its efficiency for the end in view.

The woodcut on the next page shows an ordinary portable engine, from which the chimney stalk is removed, and the usual vent for the smoke closed by a plate of iron. A huge iron fan, partially encased in a kind of jacket, and having an aperture in the back of that jacket corresponding in diameter to the opening in the smoke-box, is easily adjusted to that opening, requiring no intricate fitting or fastening; movement by means of a band being now given from the large fly-wheel of the engine to the rigger on the flyers-shaft of the fan, a great volume of hot air is drawn from the furnace of the boiler through its tubes, generating steam very rapidly and plentifully in its passage. Malting coal or coke being used in the furnace no smoke is produced, and the air thus obtained, consisting largely of



sulphurous and carbonic acid gases, is peculiarly suitable to the drying of a fermentable juice such as that contained in the beet; inasmuch as they arrest any tendency to fermentation that may have commenced. So far the apparatus is exactly the same as that shown by me last year for drying hay and wheat in wet seasons; but after many trials, finding that neither the steam hay-chamber nor the tubular wheat-house could be utilised for drying either the leaves or roots of beet, I had various shapes, sizes, and forms of cylinders constructed, and have finally found the best result from the segmented cylinder now shown; the speciality of this form of cylinder is that it presents a very large open-floor surface to the action of the hot air in a very small compass, and the air having access by the narrow spaces between the segments, as well as through the wire mesh of which those segments are made, rushes up into the very centre of the slowly-revolving mass of roots. The relative velocities of revolution of the fan and of the cylinders are of the utmost importance to the rapidity of result; when the former was driven at 1,630 revolutions per minute, and the latter at three revolutions per minute, it took 4½ hours to dry its charge of roots; but when, after several tentative changes in various ways, I increased the velocity of the fan to 2,640, and reduced the pace of the cylinder to one revolution in one minute 20 seconds, we dried the same quantity in two hours. The temperature of the ingoing air in both these cases was 520° Fah., and the outgoing 260°; the high temperature up to which I have gradually adventured in dealing with these roots, will possibly cause surprise and provoke the natural question, does it not char and utterly destroy the sugar in the root? The simplest answer I can give, is to ask your examination of the three specimens now upon the table. No. 1 is the root previously sliced into thin ribbons, and then subjected to this ingoing air at 520° for about one hour; it has lost two-thirds of its weight of water, and, although indicating here and there a few specks of char, the bulk of it is, I believe, utterly unchanged; it has kept also (unchanged by the keeping) for three weeks, and I subjected it to this test of time in view of its being possibly convenient in some cases not to carry the dessication beyond this stage. No. 2 was subjected to 520° for two hours; it shows more indication of char than the other, but that arises partly from the dessication having been carried further than it need be, and partly from some previously dried root adhering to the wire mesh of the cylinder; this specimen has parted with nearly nine-tenths of its water, and yet, as proof that the sugar in it has not undergone a change into the glucose state, No. 3 shows the crystallised sugar obtained from it by boiling alcohol precipitated again by cooling upon the sides of the bottle and the fragments of the root. No. 4 is the same root purposely dried to complete dessication; it has a brown colour, and an aroma strongly resembling chicory. An infusion of it, made in the same way as coffee, was absolutely mistaken by some of my people for that beverage. No. 5 shows the leaf of the mangold dried so as to be stored and used for food, instead of being (as now) ploughed in. By Dr. Voelcker's analysis this dried product showed a considerably less per centage of inert woody fibre and a higher per centage of azote than the best meadow hay. All kinds of stock ate it eagerly, and several practical farmers have given an unhesitating opinion that it is worth fully hay price. But to return to the subject of the root drying. I must explain that the results just described were obtained from a working model only, and not from the full-sized apparatus, but having had the relative areas of the model fan and cylinder made to the exact scale of one-fiftieth of the full size, and having tested the accuracy of the calculations thus deducible, by drying fifty times the quantity of wet hay with the large hot blast, in the same time that one part was dried by the model fan, I venture to assert that with four cylinders and one fan of six feet diameter and six feet broad, driven by a six or eight horse engine, a farmer would be able to dry 360 tons of roots in a week. Of course this calculation is based upon the expediency, which attaches to all continuous engine work, of carrying on through the night, so as not to waste time and fuel in letting steam down each evening, and getting it up again next morning. Now if we take twenty tons per acre as an average crop, three hundred and sixty tons would be the product of an eighteen-acre field. If upon the continental system it were needful to cart this quantity an average distance of two and a half miles, to a central factory, the positive cost of such cartage would be fully two shillings per ton, which would constitute a first charge of thirty-six pounds on the three hundred and sixty tons. But if the system now suggested were adopted, and these three hundred and sixty tons were carted to the portable kiln in the centre of the field in which they were grown, they could be brought in by

		£	s.	d.
2 horses and carts, at 5s. per diem each,	per week	3	0	0
2 men	at 2s. 6d. ,,	1	10	0
2 boys	at 1s. 2d. ,,	0	14	0
After drying there would be 92 tons to be carted the 2½ miles, at 2s. per ton.....		9	4	0
		£14	8	0

This £14 8s. deducted from £36 would show a saving of £21 12s. per week.

It will, I think, be conceded that whether a fixed kiln

at a factory, or a portable one in a field, be used, an engine for washing and slicing the roots, and afterwards pressing the dried root into cake or manufacturing it into sugar, would be indispensable if the operation is to be carried on to any extent; the engine, therefore, would not be a heavier charge on the one plan than on the other. The labour of charging and emptying the cylinders would not be greater than that of charging and emptying a kiln; indeed, by a little mechanical ingenuity it could probably be made less, and the consumption of fuel would not, I think, be greater in the one case than in the other, because, although in a kiln on the old principle the loss of heat by radiation would be less, on the new, that loss would surely be compensated by the novel utilization of the waste heat from the engine. So far the matter rests upon its comparative merits only, and the argument in its favour merely stands thus—that as a certain process has been found to answer abroad, if that process can be adapted to this country so as to show a saving of £20 per week in the item of cartage, it forms a *primâ facie* evidence that it should answer here also. But I have not drawn up this paper with a view to advocate blindly any pet plan of my own, but simply to exchange such knowledge as I have been able to glean upon this subject with others, many of whom probably know a great deal more about it than I can pretend to do. In this view I would ask the attention of the Society, and information from some of its members, as to the relative value of labour here and in the beet growing countries. I have waded through a great number of books and a large amount of correspondence, but I cannot find any reliable data as to the wages of the men employed or the number required for the conversion of a given number of tons of beet into their relative tonnage of raw sugar. I have obtained the latest returns issued by the Prussian Government, and am told that they are generally very correct. These give 1,600,000 tons of raw roots converted, during the year 1865-6, into 128,000 tons of raw sugar; this latter quantity gives 2,461 tons per week; and 35,000 people being employed in this industry, would show rather more than fourteen people requisite for the production of each ton of sugar. This seems a very heavy amount of labour; and I can by no means vouch for more than the correctness of the figures as deduced from the report. Mr. Arnold Baruchson, who has just returned from his establishments at Magdeburg and Douai, assures me that a man's wage there is about 12s., and a woman's 5s. per week; in that case there are many parts of England and Ireland, where labour is equally cheap, and the comparative cost of production would not be affected by the number of people employed. But if there be other districts on the Continent where men may be obtained for say 9s. per week, and women for 4s.; and if at a rough estimate we take the labour of eight men and six women as required to produce one ton of sugar, then 8 at 9s. + 6 at 4s. = 72 + 24 = 96, must be deducted from 8 at 12 + 6 at 5s. = 96 + 30 = 126s. minus 96s. = 30s., giving a nett advantage to any such district over this country of 30s. per ton on the sugar so produced. This is a large difference, but carriage and freight, and many other circumstances might reduce the inequality; besides, it is worth remark, that mere money wage does not express all the difference. The value of a body of workmen to a manufacturer is not represented solely by what they are paid, but by what they can do; if in Germany the wages of the labourer are low because he can buy his food cheaply, then the man there at his 9s. per week may be as able and willing to work as one here or in Ireland at 12s. or 15s; but if (as has unhappily been the case in the latter country especially) wage is low and food dear, such an underpaid and half-starved workman cannot do anything like the same amount of labour as his better-fed rival, and the money-cheapness of wage becomes a mere delusion. I can speak from personal experience upon this point, because, five and twenty years ago, we established a branch of our manufacture in the south of Ireland, and employed a considerable number of men at the (then) highest wage of 7s. per week. At this time we were also employing a large proportion of Irishmen in London at from 15s. to 18s. per week. Passing from one manufactory to the other I was struck with the much larger amount of work which our men in England could willingly and cheerfully do than in Ireland. The former were able to keep steadily on at hard work for hours together without flagging, and with very little disposition to shirk their fair share in it; but the others could only make a spasmodic effort whilst the eye of the foreman or the master was upon them, and, directly they believed themselves unobserved, would crouch down into corners, pull out the inevitable short-pipe, and console the cravings of their empty stomachs with enervating and unwholesome smoke. This was so evidently a question of sufficient and insufficient food that, as a mere matter of policy, we gradually raised their wages; and if the undertaking had been carried on, I firmly believe that we should have found it to our pecuniary interest to have equalised their pay with that of our London men. I have ventured to intrude this digression to indicate the fallacy of founding any manufacturing calculation upon the mere money wage in any particular country, without due regard being had to the condition of the labourer.

I have now only one more circumstance to bring to your notice, and that, also, is much more with a view of eliciting information from others, than with any pretence of conveying it myself. In the returns of the imports of sugar into the United Kingdom (with which I have been favoured by the Board of Trade), it appears that whereas, in 1859, five and a-half million hundredweights came from our colonies, and three and a-half millions came from the Continent, in 1866, about nine and a-half millions came from the former, and only about one and a-half millions came from the latter. It would be very instructive if those who are well versed in the philosophy of statistics would give an explanation of these figures. To a superficial observer, like myself, they would seem to show that our colonies have not much to fear from Continental competition, and thus indirectly lead to a suspicion that the home growth of sugar would have to compete with a colonial rather than a Continental rival.

Whatever be the ultimate fate of this manufacture, surely those who come forward and risk their capital and their credit with sufficient courage and perseverance to demonstrate either its possibility or impossibility, well deserve the warm encouragement of public opinion during their experiment, and an equally hearty sympathy and honour whether they fail or succeed. When we remember that success would, in all probability, lead to the profitable investment of some millions of idle capital, and give wage and work to twenty or thirty thousand idle men, all who wish well to their country must wish success to such an enterprise.

The establishment now commenced at Lavenham has been set afoot, as I am told, with the thorough approval and valuable advice of two of our most eminent agricultural authorities, Mr. J. Chalmers Morton (whom I am glad to see occupying the chair this evening), and Mr. James Caird; this latter gentleman, in his admirable letters on "English Agrieulture," nearly 20 years ago, called attention to this subject, and has seen no reason to alter his opinion of its importance. It is, I am also informed, being carried out at the sole risk, and under the sole management of Mr. James Duncan, a gentleman of thorough practical knowledge and long experience. Under these good auspices, and with ample guidance from past failures, and a large increase of present knowledge, I think we may fairly hope that the renewed adventure will ultimately achieve a prosperous future.

This short and imperfect review of a large question

has only touched upon a few points, I fear very superficially. It may, therefore, be of some service to those who may care to pursue this subject farther, to append a list of the works which contain valuable technical and minute information upon it. In Loudon's and Morton's "Encyclopedias of Agriculture," and Rham's "Dictionary of the Farm," very full and excellent descriptions of the best rules for growth and manufacture may be found. Lowe's "Practical Agriculture," and Stephen's "Book of the Farm," are also worth consulting upon points of cultivation, whilst Ure's and Muspratt's "Dictionaries of Arts and Manufactures" contain ample details of processes of manufacture, and statistics of consumption and imports. In Muspratt's, especially, there is a very valuable description of both this and the "Colonial Sugar Manufacture," by Dr. Angus Smith, of Manchester. In the *Agricultural Gazette* of the 28th of March, there is an interesting passage from Johnston's "Chemistry of Common Life," and a minute description of the best species of seeds, by a foreign correspondent. Two German treatises, by Dr. Fühler (not yet translated), may be obtained from Berlin, through Messrs. Assher and Co., Bedford-street, Covent-Garden; and, finally, a paper read by Mr. Arnold Baruchson before the Social Science Congress at Belfast, and a pamphlet, by the same author, now in course of publication, are doubtless both of them well worth study. There is, therefore, no lack of book-knowledge upon this matter, and it seems now only to remain to put the various processes and theories described and advocated to the crucial test of systematic experiment, in order to provide a sound and secure basis for practical enterprise.

DISCUSSION.

The Chairman said that as there were single counties in England in which no less than 20,000 to 30,000 acres of mangold-wurzel were grown annually, it was evident that the climate and soil were perfectly well adapted to the growth of the sugar beet. If therefore any gentleman had any information to give on the subject he would be conferring a public service by making it known, particularly at the present time, when circumstances seemed favourable to this manufacture being started.

Mr. Botly, from what he had himself seen of the cultivation of beet root on a small scale, thought that there were many soils well adapted to the growth of it, in the same way as turnips and swedes were now grown on land which it was formerly said would not produce them.

Dr. Voelcker thought the paper was more valuable for its suggestive character than in any other respect. He would not offer any remarks on the merits of the various systems of manufacturing sugar from beet-root, because the whole question would really turn upon the description of root which was most remunerative to the farmer. This simple question lay at the root of the whole matter,—was it more profitable for the English farmer to grow large crops for feeding purposes, or small crops for the manufacture of sugar? Although he agreed in many respects with the opinions expressed in the paper, he did not fully endorse the statement that an average crop of beet-root, useful for the manufacture of sugar, would amount to 20 tons per acre, nor could he concur in the view that as yet they had very scanty information respecting the description of land and climate suited for the growth of beet, or as to the kinds of manure best suited for the production of a large percentage of sugar. On these various topics they had very sound information, which had been accumulating during the last ten years on the Continent, and this should be taken advantage of, and the difficulties which the English farmer and manufacturer of beet-root sugar would have to meet must not be lost sight of. In many parts of England there would be a difficulty in the climate. It was not so much heat that was wanted as a dry autumn for the production of sugar in roots generally, more especially in beet. Just when the root was beginning to ripen they wanted not a very hot but a dry season. For that reason he very much doubted whether the cultivation would be successful in Ireland, or on the west coast of Britain, or perhaps even in the Midland Counties. Experience rather pointed to the eastern counties of England as the most likely field for this experiment, and he was glad to see that Mr. Duncan had established, or was about to establish, a manufactory in Suffolk, because that was a dry county, and one in which the soil was not all of the best description, some being indeed very poor land. These circumstances he considered rather propitious for the manufacture of beet-root sugar, although unfavourable for ordinary farming; unfortunately the interest of the farmer and of the beetroot sugar manufacturer would appear to be antagonistic. As soon as the farmer began to grow large crops of roots the percentage of sugar in them would fall; and as soon as his crops fell below a certain tonnage per acre he would find a difficulty in paying his rent. Land on the whole was more valuable in England than on the Continent, and land here was more adapted for the production of beef and mutton. Fattening stock did not pay on the Continent, and was, consequently, neglected; but it was just the reverse in England; so that all circumstances combined to point out to the farmer the desirability of growing large crops rather than small ones; yet this was incompatible with having a large quantity of sugar in the roots. The average per-centage of sugar in the root in England would not be more than 4½ per cent. It was a very good mangold wurzel which gave five per cent. of sugar, and it was only under exceptional circumstances, in cases were they were grown on very poor land, with a very little farm-yard manure, and no guano or stimulating ammoniacal manures, that seven per cent. of sugar was obtained. He had lately made some analyses for Mr. Duncan, of beetroots grown at Lavenham. He had found in roots of about 3lb. each, by no means large ones, in round numbers, seven per cent. of sugar. That was above the average in England, whereas in the sugar growing districts in the north of Germany, about Magdeburg and Halle, 12 per cent. was the average. That gave a very wide margin for profit to the continental manufacturer. Then, again, the value of land here tended to the employment of more capital in farming than was usual on the Continent, where manures, especially artificial ones, were not sufficiently employed, and the consequence was that crops were much smaller, but the percentage of sugar in the root was much greater than in England. In England manures were largely employed, and as soon as this was the case the percentage of sugar in the roots diminished. It appeared to him that the whole gist of the question whether beetroot sugar manufacture could be profitably carried on in England depended on the answer to the problem whether it was more profitable for a farmer to grow small crops with much sugar, and with little manure employed, or large crops for feeding purposes. He was very glad the experiment was set on foot, and no doubt in a year or two very valuable information would be obtained. No man could be found more likely to go thoroughly into the matter, and to obtain trustworthy results of permanent value, than Mr. Duncan, and even if he were unsuccessful, which he (Dr. Voelcker) hoped would not be the case, he had no doubt that very valuable lessons would be learned from his experiments in Suffolk.

Mr. W. Foster White said he had had no intention of entering into the discussion, although there was hardly any question of more importance than that before them. They all knew the large amount of sugar which was required for various purposes, even leaving out of view its domestic use. He need only refer to various manufactures, and particularly to breweries; and he could not help thinking that Mr. Gibbs must have been under some mistake in his statistical information as to the imports. He had been connected all his life, directly

or indirectly, with sugar; and he might say that that trade had lately had to encounter very considerable difficulties indeed in connection with the article of glucose. He should like to know whether the statistics quoted included that article?

Mr. Gibbs said that the returns he had obtained from the Board of Trade distinctly specified raw sugar only.

Mr. White said they had dealt with this article in England, and it was found to answer all the purposes of sugar admirably, but no sooner had they succeeded than they found they were impeded by the excise laws. For instance, he could produce from glucose an article which would be extremely useful to a certain manufacturer who desired to use it, but the excise laws stepped in and prevented the one from selling and the other from buying. They would permit the manufacturer to buy the glucose himself and manufacture the article he required, but this did not suit him; the operation was costly, a certain amount of danger was attached to it, and it was inconvenient to him to put up the requisite apparatus on his own premises. The consequence was that he had entirely failed to bring this exceedingly useful article into consumption owing to the stringency of the excise laws. Then, returning to the question of beetroot; the chairman knew very well what large amounts of money had been lost, literally sunk, in attempts to extract spirit from it, during the last few years. Upon this point, again, he happened to possess very full information; and he had no hesitation in saying that the labour and capital which had been devoted to that subject had all been lost. He was old enough to recollect the efforts of a gentleman whose name must be familiar to many members of the Society, Mr. John Howard Kyan. He succeeded in extracting spirit from beetroot, leaving behind a deposit or pulp, which, after much labour, he was able to convert into paper. The paper was brown at first, but after some difficulty he succeeded in bleaching it and converting it into writing paper. That was a very excellent operation, and showed what even 30 years ago British capital and energy could do with beetroot or anything else in the manipulation of which they were not interfered with by the excise laws. He was thoroughly persuaded that this matter was yet in its infancy. If he rightly understood the paper, the author was about to enter on a large experiment in this direction, which would be surrounded with considerable difficulties and risk, but he wished him Godspeed; and if he succeeded either in the production at a profit of spirit or sugar from beet, and if the remaining pulp could afterwards be turned to advantage in the feeding of cattle, he would be undoubtedly a great benefactor to his country.

Mr. Botly, in reference to a remark by Dr. Voelcker, hoped he might be permitted to ask that gentleman if he had not known instances of the yield per acre having been raised from 20 up to as much as 40 tons per acre by the application of manure, industry, and skill. He believed it was not large crops, but large roots that yielded less sugar, and it was now well-known that a moderate-sized swede was better for fattening and kept better than a very large one. He did not see why there should not be a good weight per acre of small or moderate-sized roots.

Mr. David Martineau, being engaged in the sugar manufacture, and using about 200 tons of foreign beet-root sugar weekly, said the subject was of great importance, and if they could get a supply of sugar at home it would be very advantageous in many ways, and they would be able to command many markets from which they were now excluded by foreign competition. At the same time they must remember that the continentals had arrived at their present success only after many years of trial and difficulty, all of which we could not escape in this country, even by availing ourselves of their experience, for the conditions were not in all respects alike. For instance, our autumns were generally much wetter, and there might be differences in the soils, and in the kind of roots best adapted to them. Independently of that, there were differences in the excise laws. At the present moment treacle was prohibited from being used either in breweries or distilleries, for both of which purposes it was well adapted; and if these laws were continued, so as to prevent the profitable employment of the treacle from the beet-root sugar manufacture, he apprehended the experiment must fail, as he understood it was so nauseous as to be unfit even for feeding cattle. Abroad it was used almost entirely for distillation. If it could be so used here it might make all the difference between a profit and loss in the manufacture. It was, no doubt, the case that the largest quantity of sugar was obtained from what would look very poor roots to English eyes; but he believed that very nearly the same weight per acre of small roots as of large ones might be produced; and if this were so, and if the small roots yielded 10 or 12 per cent. of sugar as against 3 or 4 per cent. from the large ones, that, again, would make all the difference between a profit and a loss. He might say that the trade in general wished the experiment every success, and would do all they could by offering a market for the produce.

Mr. Jones thought it very doubtful whether it would be for the advantage of the country to devote the land to the cultivation of sugar, seeing this article could be imported from abroad much more easily than beef, and they wanted the latter as much or more than they did sugar, whilst the price per pound was about double. In the present system of agriculture a great deal depended on keeping a good stock of cattle on the land, and if the root crop were sent off the land instead of being consumed by the cattle, he did not see how they were to keep up a proper succession of wheat and other crops in rotation. He believed their great object should be to attend to the feeding of stock, for on that depended the superiority of their wheat crops. He thought the average of mangold-wurzel stated in the paper was rather below the mark at twenty tons per acre, for he had recently sown some from which he was assured by the seedsman he should get eighty tons.

Mr. Pearsall agreed with Dr. Voelcker that the paper was most valuable for its suggestions, and thought the statistics were not quite reliable. It was wrong to quote figures at random, but he had no hesitation in saying that the difference between the quantity of sugar imported into this country in 1866 and the present time was so enormous as to render the sentence which was founded upon the Board of Trade returns for that year, and which stated that it would appear "that our colonies had not muuch to fear from continental competition" absolutely incorrect. The French and Germans were now saying that the day was coming when they would have to supply their own colonies with sugar grown at home. He believed that in 1867 at least 28 million pounds were imported into England. Mr. Gibbs had not pointed out how the manufacture had grown up on the Continent, nor how it was supported, nor had he pointed out to the farmer or capitalist how the processes were carried on so as to affect other produce. He believed if any one went into the manufacture here on a broad view of what had been stated as the results on the Continent he would be ruined, unless the excise laws were modified. On the Continent the manufacture could be conducted in any way that was thought proper, and the molasses could be devoted to any purpose which appeared profitable. This could not be done by a farmer in England, and therefore, without some change in the law, there would be an enormous waste. This manufacture was now carried on to an immense extent in Germany, Holland, Belgium, and France, and our colonies were driven out of the market. With proper regulations he could not imagine a better crop for the farmer, so capable as it was of being turned to account in various ways, either as food for cattle or for the use of the manufacturer.

Mr. Campin said the excise laws seemed to be regarded

in some quarters as an insuperable difficulty in the way; but if this were so, he did not think any statesman would long resist such an alteration as was required to meet the circumstances of the case.

The Chairman thought, perhaps, the best answer to the gentlemen who had dissented most vigorously from the idea that this manufacture could be introduced into English agriculture, was the fact that a very intelligent sugar refiner was about to take these risks upon himself, and offer 18s. per ton to farmers for beetroot for manufacturing purposes. He probably knew his own business well enough to feel safe in making such an offer, and on the other hand it would pay the farmers very well to grow the crop at that price. Of course it would not be to their advantage to grow an unsuitable article, but what they had to guard against was not so much a large crop as a crop of large roots. He thought perhaps it would be possible to grow a large tonnage of small roots; a single lb. per square foot would give 20 tons per acre, and surely it was possible to grow roots averaging 1lb. each over an acre. Some guidance might be obtained from what was done in Germany. He was told that in France the tax was levied on the sugar as it was manufactured, but in Germany on the root itself; and there it was found advantageous to cut off that part of the root which appeared above ground, as it contained less sugar than the portion beneath. He would venture to recommend to gentlemen about to cultivate mangold or sugar beet, to depend rather upon transplanted roots than on sowing seed; that they should not follow the practice hitherto generally adopted of sowing the seed in rows upon raised drills, which were afterwards levelled, so that the earth was taken away, and the roots were more exposed than they would naturally be, but that they should cultivate seed in seed beds, and transplant the seedings. If the ground was cultivated deeply, well manured in the autumn, and the plants put in in May with the last ploughing, planting them at intervals of 15 inches in very narrow rows about 12 inches wide, they would get a plant which would grow mostly underground, and would probably be better for Mr. Duncan's purpose. Having a plant to every square foot and a-half, if they averaged one and a-half pound per root, they would have 22 or 23 tons per acre of small roots, and therefore of good quality, which, at 18s. per ton delivered, would pay very well. It was worth any man's while to grow a green crop for which he got £20 per acre; and if the farmers in the neighbourhood of Lavenham adopted a proper mode of growing, no doubt they would find the beetroot crop very profitable. He concluded by moving a vote of thanks to Mr. Gibbs for his valuable paper, which he hoped would not be too late to have some effect on the crop of the ensuing season.

Dr. Voelcker begged leave to suggest that, instead of applying farmyard manure in the autumn, no manure at all should be used if they wished to give satisfaction to the beetroot sugar manufacturer. He knew that in the north of Germany it was made a condition with the farmers that no manure, either natural or artificial, should be used with the root crop, although it might be used with the one previous.

The Chairman said Mr. Duncan had issued the conditions upon which he offered the 18s. per ton for the roots, and he permitted the application of manure in the autumn preceding the sowing, and of bone-dust in the spring.

The vote of thanks having been passed,

Mr. Gibbs, in acknowledging the vote of thanks, said, I cannot pretend to take up and confute all the objections that have been urged against this manufacture, because I do not stand here to-night either as an advocate or an opponent of it. In many of those objections I heartily concur; in others I admit great force and cogency; and in all I see additional reason for caution and further inquiry. My own impression is that we require to know a great deal more of this subject before it would be safe to embark in it to any great extent. In the hope, therefore, of giving some little additional light upon one branch of it, viz., that of the drying process suggested in my paper, I will venture to refer to two or three more detailed and minute calculations than I could embody in the paper itself. First in the calculation for time and quantities, I assume that the drying power is proportioned to the area of the column of hot air used (velocity and temperature being equal); I take, therefore, a fan mouth of 6 ft. × 2 ft. 10 in., the area of which is 2,448 sq. inches, *i.e.*, 200 times greater than my model fan of 4 in. × 3 in., and as this latter is able to dry ½ cwt. in 2 hours, the former would obviously be able to dry 200 times ½ cwt., *i.e.*, 5 tons in the 2 hours; now 5 tons in 2 hours = 60 tons in the 24 hours = 360 tons per week. With regard to the capacity of the cylinders, I believe it will be found that four of the size indicated will hold fully 5 tons, but if more space were required, an increase of 2 ft. in these diameters, or the addition of two more cylinders would not affect the practicability of the arrangement; each set of 2 or 3 could be contained in a closed portable chamber, of the size of a threshing machine, and placed, like it, on travelling wheels. If the quantity of fuel requisite to drive off this large bulk of water were found too great to pass through the furnace of the engine, a supplementary furnace of any desired size might be improvised upon the field by the aid of a few fire-bricks and furnace-bars, and the hot air from it led into the same fan already attached to the engine. This fan is by no means an unwieldy thing; when placed upon wheels two men can get it into position very quickly and easily. Touching the question of cost for fuel, having been able, with a very imperfect arrangement of firing (wherein a heavy loss by radiation largely reduced the effective result), to expel 7 lbs. of water from these roots with 1 lb. of coke, I think I may fairly assume that with better arrangements, one ton of coke will expel 8 tons of water, leaving 2 tons of dry product. Taking coke at 20s. per ton, this shows a first charge of 2s. per ton on the roots so dried; but this must not be estimated as wholly an extra charge on the ultimate manufacture, because this drying largely reduces the cost of fuel in the final evaporation; and if the alcoholic process for extraction of the sugar came to be adopted, this preliminary drying of the root is absolutely essential. Dr. Paul, in an able paper read here last Wednesday, estimates 600° or 640° as the temperature of the air which is inevitably wasted in engine furnaces, and the consequent loss of fuel at 40 per cent.; now as I have been able repeatedly to take this hot air, and by passing it over three cylinders containing wet roots, reduce its final temperature to 140°, there would seem to be a considerable saving in this utilisation. If traction engines came to be ultimately employed in this process, Captain Selwyn's evidence that 1 lb. of napthaline will evaporate 23 lbs. of water, would seem to point to a very advantageous use for liquid fuel rather than coal or coke. We have no sufficient data for estimating the labour and other costs in this country, but as a basis of calculation, I will read the statement given by M. Scheutzenburg of the total expenses of kiln drying at his works. He states that—

	Francs.
40 hectolitres of coal, costing 60f., will dry 40,000 kilos of roots, or about 40 tons,	60
And the labour amounts to, 20 days women's wage, at 80 cents.	16
14 days man's wage, at 1f. 5 cents.	21
Interest on kiln, costing 14,000fs. at 7 per cent.	11
Total	108
Now, if we double the "wage item" to assimilate it in some measure to the cost of labour here, it will add 37fs. more to that total	37
Making	145

40)145(3 francs 25 cents. per ton on the roots,
120

25 or about 2s. 9d. per ton.

This therefore does not sound like a fatal or prohibiting cost upon this particular process; indeed, if dryage can be effected at this, or even somewhat larger cost, farmers in far-away and out-lying districts might find their account in adopting it, for the mere purpose of being able to send their produce to distant markets, where they could obtain for it a higher price. I have been told by a practical farmer, of large experience, that many times, when mangold is worth 18s. to 20s. per ton near London, it might be purchased for 7s. 6d. at the far-off farms. Now, 13s. 6d. per ton looks like a fair margin to cover a cost of 2s. 9d., or even double that sum. Before concluding I would ask permission to mention some of the many purposes to which this particular mode of drying may be applicable. The Duke of Sutherland, for whom I am having a wheat-house and hot-blast constructed, intends to have it used not only for harvesting hay and cereals, but for drying peat for fuel on his Dunrobin estates. A gentleman who has large sugar plantations and factories in Demerara, considers it would be of great value there for drying the sugar cane after the extraction of the juice, so as to render it immediately available for the furnaces. General Askwith, the late superintendent of the Royal Gunpowder Works at Waltham, spoke favourably of its probable utility in drying more rapidly the wood required for the charcoal which is used in the manufacture of gunpowder. Mr. Brandreth Gibbs suggested that it would form a valuable and manageable means of preparing agricultural seeds for export to the colonies. Mr. Arnold Baruchson considers that it would be an advantageous mode of drying and roasting chicory; and others have suggested its use in the desiccation of fresh vegetables for ships' stores. It appears, therefore, that the economical and easy utilisation of a volume of hot air, practically unlimited in quantity, and perfectly under control as to temperature, gives a power that may subserve many various uses both in agriculture and manufacture; and if it proves in any way serviceable to the special manufacture which we have been discussing to-night, I shall perhaps be excused for bringing it to your notice. It now only remains to me to thank you very much for the kindness and patience with which you listened to my hasty and imperfect paper, and to express my belief that the discussion which followed it will be of great value.

PRESERVATION OF MEAT.

SHIPMENT OF MEAT TO ENGLAND.

On the 4th February a meeting of gentlemen interested in the success of a project for the shipment of all the surplus meat of the colony of New South Wales to England (under what is usually known as "Mr. Mort's Freezing Process") was held in the Chamber of Commerce, at the Sydney Exchange, the Hon. Charles Cowper in the chair. Nearly 300 of the most influential gentlemen in the commercial portion of the colonial community were in attendance, a large number of the names of whom were placed upon the committee formed shortly before the close of the proceedings.

The CHAIRMAN said that it had been required that some person should be found to step forward, and with sufficient enterprise to see whether Mr. Nicolle's discovery could be made practically available. That person had been found in their valued friend and fellow-colonist, Mr. T. S. Mort, who had kindly intimated his willingness to attend and explain his views. The time had arrived when the boiling-down process was no longer that by which it was desirable for them to dispose of their surplus stock, in the face of the fact that there was a sustained demand for meat in England, which it might be possible for the colony to supply. It was with a view to the furtherance of this idea that Mr. Augustus Morris had already gone to England. They all felt that Mr. Mort ought not to be left to carry out this great enterprise alone, without that co-operation and encouragement which they were all desirous of giving him. He should call upon Mr. W. Forlonge to move the first resolution.

A motion was then made by Mr. FORLONGE, seconded by Mr. RICHARDSON, and carried,—"That the chairman do now wait upon Mr. Mort, and intimate to that gentleman that this meeting will be much gratified if he will submit to it any information he possesses relative to the exportation of fresh meat under the freezing process, and also if he will say in what way the colonists interested in such export can aid in the advancement of his enterprise."

The Chairman and some other gentlemen then left the room, and returned with Mr. T. S. Mort, whose appearance was received with applause.

Mr. MORT said he could not but be very much gratified at seeing so large and so influential a meeting assembled to investigate a matter in which he certainly took a deep interest, although its importance to him individually was, in reality, nothing, as compared with its relative importance to the community. He was of course personally interested in the general utilisation of this freezing process; but when that was said it must also be remembered that his friends, Mr. Morris and Mr. Nicolle, were likewise deeply interested therein—the former having given great attention to the carrying out of the idea, and the latter being its actual discoverer. The process which had been erroneously alluded to as "Mr. Mort's Freezing Process" was, in fact, not his at all; the discovery was Mr. Nicolle's—his was only the enterprise—the practical application of the discovery which the genius of Mr. Nicolle had perfected. At the time that he (Mr. Mort) had been engaged in investigating a process for preserving meat which had been discovered by Mr. Blaxland, this refrigerating scheme had been suggested to him by Mr. Morris, but he had not then paid much attention to the idea. Subsequently, however, on finding that Mr. Blaxland's plan for preserving meat could not be made available to the extent that he had desired, he had more fully entertained an idea of the freezing process, and Mr. Nicolle's gradually perfected apparatus had been the result. To the great Faraday they were indebted for the principle which Mr. Nicolle had so successfully applied. It was twenty-eight years since it had been discoverd by that eminent chemist that cold might be obtained by the liquefaction of ammonia, and now there was every reason to believe that that principle might be so beneficially applied as to promote the well-being of thousands. Gentlemen had waited on him (Mr. Mort) to acquaint him with their desire that he should accept at their hands some assistance in his enterprise. Now, he wished it to be understood that he had taken this up as a mercantile speculation, and could do nothing which would interfere with that position. These gentlemen said they wished for their own sakes to further the enterprise by assistance. They asked him to accept at their hands as much meat as he was prepared to take home, and they would pay the freight of the same. A meeting like this could not be assembled without impressing on him a sense of how much he owed them for their kindness and good-will towards the enterprise. His idea was, to bring it to a successful issue, it would be necessary to go to work on a considerable scale. A mere experiment of fifty tons would not, owing to the prejudices existing in England, be recognised in that mercantile spirit by which it was necessary it should be met in order to convince people of the value of the process in a commercial point of view. Almost anything could be carried out as an experiment if money enough was spent upon it; but in this experiment they had not only to show that they could send the meat

of these colonies to England, but that they could send it as a mercantile success; and to do this they ought to send at the first not less than 250 to 300 tons. If Mr. Nicolle and he were not mistaken, and nothing untoward occurred, in about six weeks, or at most two months, he would be in a position to say, "If you are ready with the meat, we are ready with the freezing apparatus and the cylinders for the meat." If they would be so go good as to entrust the meat to his care, his first object on arriving in England would be to realise to the extent of their outlay, which would be repaid to them, and the balance of the meat would be taken by him (Mr. Mort) to distribute through England and France, so as to make the enterprise as widely known as possible. Mr. Morris, in a letter from England, while stating that no invention of the kind had been thought of in Europe, had informed him that a very strong prejudice existed against meat preserved by means of cold, and that nothing but experience would convince the people of England that meat so kept would not putrefy immediately after thawing. He (Mr. Mort) had read and otherwise ascertained the cause of such putrefaction. Albumen in combination with water, of all substances, most easily becomes putrid. When a beast is killed in a cold climate the pores are very quickly sealed up by the cold. It neither bleeds properly, nor "breathes" properly. All who have watched a beast on a cool day after it was killed must have observed the vapour which rose from it—that is called breathing. Now, in a freezing climate, both the vapour and the blood are congealed in the beast; and the albumen of the blood combining with water forms a substance which readily decomposes. But, in our case, a beast is killed in a climate in which it is allowed to bleed properly, and to breathe properly, and they knew for a fact that no such consequences followed in the meat frozen by Mr. Nicolle's plan. Meat which had been kept for months in their cylinder, and afterwards hung for days, had been eaten by many of those present, and they could testify to its being as fresh and palatable as fresh meat, and that no change whatever was perceptible in it—the sole operation of this process being, in fact, to arrest all change. Their experiments showed that their frozen meat had an advantage of from twelve to sixteen hours over meat fresh from the butcher. A strong prejudice exists also in London against the mutton of this colony, and he had lately seen an extract from the *Times* in the *Sydney Morning Herald*, saying that our "inferior mutton" would have to be much improved before the English people would eat it. Now, in the first place, he was at a loss to know what opportunity they could have had of forming this judgment; and next he maintained that our small mutton was equal to the finest produced in England. Still there were these prejudices to contend with; and he felt that in order to enable him to combat them successfully, he could with a good grace accept any balance of meat that might remain after the sale of that which might be required for the repayment of the outlay contemplated by the promoters of this meeting. It would be necessary to give away a great deal; indeed, success could only be attained within any reasonable period of time by extensively disseminating it throughout England and France; and he would here beg to say that whoever may have the selection of the meat must take the greatest care that the quality shall properly represent our production. And now, as to the probable cost of the process per pound; he had gone into the calculation very carefully, and the result he had arrived at was, that after paying all expenses, including freight, working expenses, interest on the cost of machinery and cylinders, it would, if carried out on a large scale, amount to somewhere about 1d. per lb. If that was correct, there could be no question that the shipment of meat from here was a possible thing. The *Times* published a round robin by some butchers, who stated that they were paying on the average for joints of beef in June, 8¾d.; in July, 8½d., in August, 8½d.; in September, 8¼d.; in October, 8½d., and for rumpsteaks and loins, in June, 10d.; in July, 10d.; in August, 9½d.; in September, 9d.; in October, 9¼d.; in November, 9¾d. With an expense of only a penny a lb. we have a magnificent margin for profit left. There are in England thirty millions of people, in France thirty-five millions. There are in the colonies forty millions of sheep. The average increase of sheep is one fifth; so that the increase of forty millions is eight millions. Take off two millions for our home consumption (much less than what it really is) and that leaves six millions to be shipped for England and France. That would be only one-tenth of a sheep per annum for each individual. They could not possibly overdo those markets. If we were prepared to send home all our surplus mutton—and he took no account of the beef, as that would not be much—we could not make an impression on these two countries. We could not do away with the use of horseflesh. Mr. Morris had had a long talk with Mr. Larnach and Mr. Campbell Tertius, and they said that if the plan was at all what he represented it to be there would be no difficulty in carrying it out by a company. In fact, there is at present no topic that excites so much interest in England and France as this meat question; and the feeling is very strong that meat must be obtained from Australia and elsewhere by some means or other. All depended, continued Mr. Morris's letter, on starting from Sydney and arriving in England with a cargo of well-preserved meat. Some other letters did not speak quite so hopefully. There is great difficulty in pressing anything forward in England, in the present depressed state of things and the general want of confidence. His (Mr. Mort's) brother, a very cautious man, told him if he went home—as he conceived he must do—he should go armed with every testimonial he could possibly bring. Now, no better testimonial could go before the British public than the one they were proposing to give, and no greater proof of confidence could be given than that they were willing to entrust him not only with their property, but with the conduct of an enterprise on the successful carrying out of which so much depended. In a matter of such great and universal interest, he thought our Legislature might well step forward. He held in his hand a copy of a bill to provide for the exportation of meat to Queensland. They offered 10,000 acres of land to the man who first landed 100 tons of uncooked meat in England. There was a bonus at once. And it would be no small advantage in forming a company for the carrying out of this scheme, to be able to hold out an inducement of this description from New South Wales. Things of the kind ought to be largely supported, and it would be well that such an inducement should be in readiness to offer to any company of capitalists who might be found willing to enter upon the development of this all-important business. Amongst the pleasures he anticipated in the realisation of this scheme, not the least would be the credit that would be reflected on Australia by the genius of Mr. Nicolle. He deemed it to be an achievement of which the colonies might fairly be proud, that in spite of the greater necessity that existed for an invention of this description in England, the plan should be evolved in New South Wales. He felt sure that the transport of fresh meat would not be the only advantage to be derived from the power of obtaining cold. It would prove to be a mighty agency—the opening up of a great avenue for industry, with roads branching from it on every side. He confidently believed that if cold could be obtained at the price he expected, the social condition of the old world would be altered, and the necessaries and comforts of life brought to every man's door at a rate hitherto unknown.

A vote of thanks to Mr. Mort "for the very valuable information just imparted, and for the public spirit and energy with which he has carried out so far to a comparatively successful issue, an enterprise in which the best interests of Australia are so materially concerned,' was then moved by Mr. Hay, seconded by the Hon. M' Busby, and carried.

Mr. Mort, in acknowledging the compliment, said he had been asked what would be the effect upon wool freights if meat became an article of export? In answering, he might say that commerce would be sure to right itself; but as the matter, if rightly worked out, might, in his opinion, be turned to colonial advantage, he would, with the permission of the meeting, answer the question more fully. If the holds were taken up by meat they would doubtless require more 'tween deck room. In rough arithmetic, two 'tween decks would make one hold, and it would, therefore, be necessary to double our shipping to provide room for wool. That settled the question on this side the water. The question then arose, how shall we fill the extra ships with outward freight in England, as ordinary cargo would not be forthcoming for the immense amount of shipping; and, if vessels came out half-laden, return freights would certainly be called upon to make up for the loss? To a small extent freights would doubtless increase, as many deliveries—such as fish, game, &c.—would find their way out, but as a rule the holds would carry all the cargo the colonies could take, and these goods could be stowed in the meat cylinders. But his (Mr. Mort's) idea was to fill the 'tween decks with living freight, and so make our operations to have a double blessing attached to them—that of bringing the people to the meat as well as taking the meat to the people. Both the late and the present Governments had initiated plans favourable to immigration, which we all well knew was life-blood to the colonies. With the help of the Government, therefore, these 'tween decks might be availed of for immigration purposes; and as fresh meat could be supplied at about half the cost of preserved provisions, immigrants could be brought out at a much lower rate than heretofore; and if they were allowed to pay a portion of their passage-money, and the Government would supplement the amount by a £10 land order for each person landed, our prosperity would be increased and our shipping difficulties overcome.

A resolution was then moved by the Hon. P. A. Jennings, and seconded by Mr. John Richardson, "That subscription lists be opened for the purpose of raising funds for providing meat for shipment, and for the payment of the freight thereof." The resolution was put and carried as before.

Sir W. Manning moved that the gentlemen whose names follow be appointed a committee to carry out the objects already approved by this meeting, and for placing the meat to be purchased at the complete control and disposal of Mr. Mort, with power to add to their number, and to take steps for securing the co-operation of the neighbouring colonies, and to form sub-committees in those colonies.

Mr. Alexander Stuart seconded the resolution, and the lists as finally adopted, comprised the following names:—Messrs. Charles Cowper, John Young, Edward Flood, F. H. Danger, H. Glen Walker, William Macleay, G. King, W. Dumaresq, Percy Simpson, A. Walker, Charles Smith, W. Forlonge, Edward Lee, P. A. Jennings, John Morrice, William Busby, Sloper Cox, Edward Knox, Edward King Cox, Thomas Skinner, Francis Lord, James Tyson, R. P. Raymond, John Blaxland, Andrew Loder, John R. Howe, J. B. Rundle, William Norris, James Laidley, Charles D. Bardwell, Marshall Burdekin, T. A. Murray, J. T. Ryan, Walter Hall, W. F. Richardson, Seymour Marten, Edward Wienholt, William F. Lambert, A. J. Mackinnis, Walter Douglas, Arthur Bloomfield, Matthew Young, J. Eales, George Loder, John Frazer, J. J. Phelps, J. Buchanan, John Wyndham, Charles H. Lloyd, H. Hassell, John Robertson, S. C. Burt, John Musson, W. B. Tooth, James Chisholm, Philip G. King, Thomas Icely, Thomas Rutledge, C. W. Lord, W. Grahame, J. C. Ryrie, John Eales, John Brewster, John D. Macansh; William Nicholson, T. E. Lance, Jean Te Kloet, S. D. Gordon, George Rouse, H. R. Blackman, Thomas H. West, John Browne, Robert W. Smith, John B. Suttor, F. B. Suttor, George Campbell, Euston Bloomfield, William Lee, jun.,; Shepherd Smith, H. Gordon, John Alger, John Hay, Arthur Hodgson, Tertius West, F. Bucknell, G. A. Lloyd, — Higgins, H. Moore, W. Trebeck, J. Murray, James Henderson, Alexander Stuart, Sir William Manning, Messrs. John Christie, S. B. Daniels, John Humphrey, J. F. Frith, John Richardson, James White, Thomas Hungerford, George Thorne, Edward Moriarty, Holden Molyneaux, — Landale, William Archer, — M'Hardy, A. S. Webster, Dr. Jenkins, and W. H. Eldred.

The resolution was put, and carried as before.

It was then moved by Mr. George King, seconded by Mr. A. Hodgson, and carried,—"That Mr. Edward Knox and Mr. John Alger (formerly Treasurer of the Society of Arts) be requested to act as hon. treasurers."

Dr. Bedford moved the sixth resolution,—"That Mr. R. P. Raymond and Mr. Trebeck be requested to act as honorary secretaries, with power to appoint a paid secretary."

Mr. S. C. Burt seconded the resolution, which was carried unanimously.

M. Jules Joubert, a native of France, said that in England, beef and mutton, although selling at 8d. and 10d. per lb., still was to be seen on every man's table, while in France, not only in the lower classes, but in many of the middle classes, meat is scarcely put on the table above once a-week, and then looked upon quite as a luxury. I consider, gentlemen (said M. Joubert), that the admirable scheme entered into by Mr. T. S. Mort, in which you seem all to join so heartily, will achieve for my countrymen more than has ever been done by our Government, and I feel sure that the promoters of such an undertaking will be looked upon in France as public benefactors.

A vote of thanks to the chairman was moved by Mr. Matthew Young, seconded by Mr. T. S. Mort, and carried by acclamation.

ROYAL IRISH INSTITUTE.

The following is from the *Athenæum*:—

"Ireland to the rescue! We are a failing and falling people; slackening in the race, drooping in the flight, going down in the strife. The neighbouring nations are all passing us on the road to wealth and honour. But we have one last chance of life. We may call the Irish to our aid, and so restore the balance of forces now so heavily turned against us. This aid we can procure—this insurance we can effect—at a comparatively trifling cost. We have only to found—under some such name as the Royal Irish Institute—a new South Kensington Museum in Dublin. At the small cost of £100,000 a-year the thing may be commenced.

"We are not jesting; indeed, although fully conscious that the project now put forward in Ireland will be scouted by many as a mere job, we confess to an opinion that there is something in it worthy of serious thought. The Committee, which dates from the Mansion-house, Dublin, puts the case of English need and Irish sympathy in this rather striking way:—'In the fifth report of the Commissioners of the Great Exhibition of 1851, prepared by the Right Hon. Gathorne Hardy, will be found the unanimous opinion of the most eminent men in practical science, art, and manufacture, "that the English workman is gradually losing in the race of competition through the superior intelligence which foreign Governments are carefully developing in their artisans," and that "if we are to maintain our position in industrial competition, we must oppose to this national organisation one equally effective and complete. If we continue the fight with our present voluntary system we shall be defeated, and generations hence we shall be struggling with ignorance, squalor, pauperism, and crime." We believe that the native taste, quickness, and perception of the beautiful which characterise

Irish genius will supply the very elements necessary to place English manufacture above all competition.' Put in that way the offer of help is at least generous. Who can say that the Irish have not a special faculty in the finer arts? Who are our most distinguished artists? Are they not Irish? Who is our chief painter? Maclise—an Irishman. Who is our chief sculptor? Foley—an Irishman. Who is our chief actor? Macready—an Irishman. The fire, the fancy, and the elegance of Irish genius cannot be denied; and, therefore, this promise of help is not to be treated as a passing jest.

"Ireland," says the Committee, "is as yet an almost unbroken field for industrial and art manufactures; its cultivation is certain to produce abundant and profitable fruit. The youth of Ireland are singularly intelligent, docile, quick-witted, and ready at expedients. It is admitted that they have a natural taste for art; and the number and value of the prizes won by them in art-competition against the pupils of English schools, notwithstanding the difficulties which impeded them, ought to impress the State that they have hitherto neglected an element now absolutely necessary for the maintenance of the manufacturing supremacy of England. The ancient works of art in gold, jewellery, and stone preserved in Ireland attest the native taste of past generations. The grace and beauty of ancient Irish ecclesiastical architecture charm to this day, even in their ruins; and we can point now to the restored cathedral of St. Patrick as an enduring testimony to the genius of our ancestors. The beautiful sculptures of the new Museum buildings in the University of Dublin—sculptures designed as well as executed by the artisans alone—prove that this taste and elegance of design are hereditary.'

"All that Ireland wants, is a little help in coming to our help. Ireland, rich in genius, is poor in pelf. It wants a little money, nothing else. It has within itself every other condition of success, even what the auctioneers call an unrivalled opportunity—such 'an opportunity,' to use the words of the Committee, 'as never occurred before, and cannot return again, and such as a legislator anxious to conciliate a people would desire to attain.' Yes; here it is. 'The extremely beautiful building and grounds of the Dublin Exhibition Palace are for sale. They can be purchased for about £90,000. No metropolis possesses so admirable a site for a Royal Institute as this. The magnificent entrance-hall of the Palace seems to have been constructed for the display of sculpture; the galleries would form an unrivalled place for the exhibition of paintings; the lecture-halls cannot be surpassed for convenience, extent, and acoustic properties; there is ample space for displaying in the most effective manner vast collections of raw and manufactured material, so that there would be an exhibition of manufactures at all times open and accessible. The Palace, in fact, can be made an Irish Kensington, in immediate connection with the industry, the science, and the art of this kingdom. With the Royal Irish Institute may be incorporated the Museum of Irish Industry, the Geological Survey of Ireland, the Royal Hibernian Academy, and other kindred institutions; while the Royal Dublin Society, with extended means and increased influence, would pursue with it, in a parallel line, its most useful and patriotic course. If on such a question it is permitted to descend to pecuniary considerations, the rent saved by the concentration of these societies in the one building would amount to double the interest on the sum required for its purchase.' The whole thing, in fact, is cheaper than dirt.

"'To accomplish this great design, and to render the Institute not merely permanent but useful, a grant of £100,000 per annum is required. A less liberal amount will not suffice.' This is quite frank. For the small sum of £100,000 a year, Irish genius will come to the help of English sloth and stupidity, and aid us to redress the balance of nature.

"Apart from jest, we think our Irish friends have a real claim to consideration in such matters, though we doubt whether they have put their case in a winning way."

HAMPTON COURT PALACE.

Hampton Court Palace, open to all classes without payment every day in the week except Fridays—and especially thronged on Sundays by artisans and their families—was the subject of discussion in the House of Commons, when an attempt was made by Mr. Labouchere, the member for Middlesex, and by Mr. Alderman Lusk, to reduce the vote for repairs. The following appropriate remarks are extracted from the *Times*:—

"What, then, is the position of Hampton Court Palace and gardens, and their claim on the national purse? We have not too many palaces or public gardens. We have not too many spots for a day's "outing." Our own metropolis and suburbs are not overdone with the historical monuments, the picture galleries, the vestiges of old, the objects, curious, quaint, or picturesque, that we travel a thousand miles to see, with passports and heavy purses in our pockets and red books in our hands. When the happy day comes at last—that long-looked for holyday which the sun at last smiles upon—one is not embarrassed by the variety of excursions presenting themselves. Some of the number are not very inviting. A regular Londoner has little relish for at least half the items in a Stranger's Diary. There are things, not without their value, which it is sufficient to have seen once, perhaps thirty years ago. On the other hand, there are a few, very few, places which are always enjoyable. They are graceful; they are calm; they offer beauties to the eye and associations to the mind. Hampton Court Palace happens to bear the palm in this last mentioned, very rare, and very precious class. The stateliness of the buildings and gardens, the sweet tranquillity of the scene, the dignity of the immense façade and long broad walks, may predispose and raise the dullest mind and the most jaded spirit for the very strange and very eventful story of the place. That story is the history of England for 200 years, beginning with the rise and fall of Wolsey, and only ending with George II. During that long period, kings, queens, ministers, protectors—more than one—ecclesiastics, from the great Cardinal to the Presbyterian divines—every kind of greatness or notability has left its mark here, and stamped a recollection. The Palace has been a court and a prison; it has even been the property of a private individual, but more generally the fitting edifice for State ceremonies, sumptuous entertainments, Royal marriages, Church conferences, and the reception of foreign potentates and ambassadors. It seems to have been to everybody's taste, for every successive holder of power, during the whole of that ever-changing time, whatever else he liked or disliked, liked Hampton Court. Henry VIII. certainly did, and all his family after him; both Charleses, and he that came between them; William III., its second founder, and his successors to the second George. The architecture writes its history large to the eye of those who require this scale of instruction. An exceedingly curious and interesting collection of a thousand pictures supplies characters, names, and incidents to those who can look closer into the past and take in more. When the visitor is tired of the pictures, there are the gardens; and when he wants a change, there are the river and the park. On any fine Sunday in the summer—indeed, on most fine days—one may see that Hampton Court is appreciated, and that it is a palace of the people. In truth, it is our Versailles, and if not so vast as that greatest of Royal follies, is large enough for enjoyment. Out of a public expenditure now amounting, we are sorry to say, to seventy millions, Mr. Lusk and Mr. Labouchere wish to save £5,000 by cutting down the allowance for this place of popular resort, curtailing the attractions, reducing the scale of repairs, and putting the whole place on what is called an economical footing.

"Such a saving would be singularly misplaced, and out of all proportion with the generally handsome scale of our public expenditure, or, indeed, with a much less handsome scale. Why are the people—for this is a people's question—to be grudged the full enjoyment of their own palace? They do not grudge its royal name, for its story is that of royalty; but they accept it as a gift of royalty to themselves. Nobody here would like it better if it were called a museum. Nor does the public grudge that the palace should still be occupied, for the sentiment of utility itself suggests a preference for an inhabited building. There is no ground for importing invidious comparisons into so simple a matter, but it would be easy to point out expenditures of ten, twenty, or fifty thousand pounds for which the public had much less advantage, and of which, indeed, they are likely never to see the fruit at all. These gentlemen have taken up a very good cause, for the economical use of our means and opportunities is a sacred duty, incumbent upon States as upon private persons. Economy, however, is a thing to be studied, for it is a science; and carefully practised, for it is an art. Nothing depends more on the rule of proportion. It is easy to be penny wise and pound foolish—many thousand pounds foolish, for that is the colossal disproportion of these days. It is no small difficulty, not to say calamity, that the purse our Parliament has to deal with is almost inexhaustible. Our resources being apparently infinite, we cannot distribute them in finite proportion or frame any just system at all. We do it by fits, for want of a method, After a hot fit of extravagance, when, perhaps, Parliament had lost its head altogether, it cools into a cold fit, and repents of its late extravagance in shabbiness and cheeseparings. The inevitable result is a reaction, when Parliament rewards itself for saving five thousand pounds by throwing away, perhaps, five hundred thousand; all the quicker, perhaps, because the object is inappreciable."

PROPOSED ARRANGEMENT FOR TECHNICAL EDUCATION IN FRANCE.

A draft bill was laid before the Corps Législatif last year, the object of which was the establishment of a separate and special system with respect to technical or professional education, under the Ministry of Agriculture, Commerce, and Public Works. The draft was submitted to a committee in the usual way, and M. Chauchard was appointed reporter, but nothing has been heard of the subject since, and it was supposed to have been abandoned.

It appears, however, that such is not the case, for the Minister of Agriculture and Commerce has addressed a circular to all the Chambers of Commerce in France, calling attention to the proposed arrangement, and quoting the objects of the draft bill in the following terms:—"1. To regulate the legal position of the establishments now existing, and of such as may in future be created; and 2. To assure to the administration the means of giving to establishments for technical or professional education, both moral and pecuniary support by the aid of subventions and rewards."

In the circular in question the Minister requests the Chambers of Commerce to examine a new system of organisation (not made public) for the formation and management of such schools, and to report to him thereupon. The committee entrusted with the draft bill awaits, it is said, the result of this appeal to the Chambers of Commerce.

It is scarcely necessary to add that not only are all technical schools at present under the Minister of Public Instruction, but that nearly the whole of those which have been established of late years have resulted from the efforts of M. Duruy. The separation of one class of establishments from the other is entirely a new idea, and will doubtless give rise to considerable discussion.

Fine Arts.

Archæological Exploration at Rome.—A fund is being raised under the auspices of the British Archæological Society at Rome for this object. In a circular issued by the promoters, they point out that while there is no city in Europe that possesses so many objects of historical interest and importance as Rome, there is no place where so many important additional discoveries may not still be made, or so much valuable information be obtained by a very moderate expenditure of money. Many historical questions of considerable interest can only be solved by a more careful examination of the remains of ancient Rome than has ever yet been made. Many passages in classical authors relating to the topography of the city admit of two interpretations, and the right one can only be obtained by archæological investigation; that is, by the careful examination of the remains still existing. To enable archæologists to make these examinations, they must be able to see the construction, but by the filling-up of the fossways of the time of the kings of Rome during the period of the empire, and by the accumulation of the rubbish of old buildings in the middle ages and in modern times, the portions that remain of the original construction are often buried twenty feet deep, or sometimes more. It is only therefore by excavation, and by getting access to cellars or subterranean quarries, or watching the rebuilding of houses, that the archæologist can pursue his explorations and investigations. For this purpose a special fund is required, and the British Archæological Society of Rome propose to act as trustees for such a fund, and to undertake its direction, with the consent and approbation of the Government. The art of photography will enable the society to show how the fund is applied. Photographs will be taken showing the progress of excavations that may be made or of works of art and antiquity that may be discovered, copies of which will be sent to the subscribers. Subscriptions will be received by Messrs. Coutts, to whom they are to be paid to the credit of the Treasurer of the British Archæological Society of Rome, Mr. J. H. Parker.

Colossal Statue of the King of Italy.—A colossal equestrian statue of his Majesty Victor Emanuel, King of Italy, modelled by the sculptor Salvino Salvini, of Leghorn, is about to be placed in the new Piazza Vittorio Emanuele at Florence, near the Cascine, and exhibited to the public during the festivities which will take place on the occasion of the wedding of the Prince Humbert. It then will be taken down, and cast in bronze by the well-known founder, Clemente Papi, of Florence. This immense statue, which is one of the largest in Europe, measures eight metres in height.

Manufactures.

Paper Material.—The *Paper Trade Review* says:—"Several paper manufacturers of the east of France have jointly offered, as a prize, a medal and the sum of 4,000 francs to whomsoever will produce and apply in France any economical filamineous matter which, in the state of paste, may serve for the manufacture of paper, and which, when mixed with three-fourths of rags, shall make a paper of as fine a quality as if mixed with rags alone. Medals will also be given (1) for the best processes for discolouring and bleaching rags; (2) for the best size for paper; (3) for an apparatus or any process which may neutralise the electricity which develops itself in the paper while it is in the machine, and which is hurtful to its manufacture; (4) for a statistical work on the state of the paper manufacturing industry in the principal countries of Europe and in America.

Havre Maritime Exhibition.—Our leading shipbuilders, engineers, and others, are likely to be well represented. Messrs. R. Napier and Sons, of Glasgow, who carried off the Grand Prix at Paris last year, are again exhibitors. Messrs. Randolph and Elder, who have a dozen new vessels nearly completed in their extensive building-yards on the Clyde; Messrs. Gourlay Brothers, of Dundee; Mr. James Laing, of Sunderland; Palmer's Shipbuilding and Iron Company, Jarrow; Mr. G. Farrans, North Shields; Messrs. Earl and Brownlow, and Lumsden and Co., of Hull, send models; whilst anchors, chains, cables, ropes, sail-making, fishing tackle, preserved provisions, and other industries will have numerous exhibitors.

Manufacture of Musical-boxes in Switzerland.—The visitors to the Exhibition at Paris, 1867, may remember having seen in the Swiss department a goodly collection of musical boxes, charming the public with their pretty and often complicated airs. The chief centres of production of this agreeable knick-knack are Sainte Croix, in the canton of Vaud, Teufenthal, in the canton of Aargau, and Geneva. At Sainte Croix there are not less than 30 manufacturers of this article, employing upwards of 700 hands; about two-thirds are engaged in making the smaller or snuff-box size, and the remainder the larger, or, as they are technically termed, *carlets*. The aggregate annual production is valued at two millions and a-half francs, or thereabouts. At Geneva there are seven establishments, counting 300 hands in all, which are exclusively devoted to the manufacture of the different parts of musical-boxes. Six other firms, occupying 200 workmen, do nothing but mount and adjust the pieces, and ultimately export the finished article. The number of boxes of all sizes annually made at Geneva is about 6,000, representing a total value of 700,000 fr. (£28,000). The prime cost of a small box is 40 fr., and for a large one varies from 200 to 500 frs. The manufacture of musical birds partakes rather more of the nature of jewellers' work; they are fitted with pretty gilt boxes, from which they emerge when the latter are wound up. There are only two firms in Geneva engaged in this special line; in the aggregate they do not produce more than 100, which are sold at the rate of from 500 to 1,000 francs each.

Manufacture of Combs in Italy.—The manufacture of combs in Italy is carried on principally in Lombardy, Tuscany, and the Neapolitan provinces. In Tuscany, especially at Florence, Leghorn, and Arezzo, they are made chiefly of ivory and bone. At Naples they manufacture excellent articles from the hoofs of bullocks and horses, and also from tortoiseshell. In Lombardy the manufacture of ivory and tortoiseshell combs is very limited, whilst on the other hand a great trade is carried on in combs of bone. Milan may be said to be the chief seat of this manufacture, supplying not only Lombardy, but the whole of Italy. This industry has not been carried on in this city for more than thirty years. Formerly there were only a few small manufactories, where this industry was carried on in a most primitive manner, and the produce was either bad or costly. At the present time there are two large manufactories of combs, occupying about 200 workmen, and eight smaller ones, occupying from six to eight men each, and besides these there are many artisans who work at their own homes for the manufactories. The total number of workmen employed in this industry is about 250. In the other provinces of Lombardy there are several small manufactories. At Milan 4,000 horns are used per week—that is to say, 208,000 horns yearly, representing the value of 150,000f. (£6,000). The total value of the production is estimated at half a million of francs (£20,000). The principal part of the raw material is purchased in the country, but some is obtained from South America, Brazil, Montevideo, and from Buenos Ayres. The refuse of the manufacture, such as the tips of the horns and the scrapings, are used by turners, and also are employed for manure for the cultivation of olives and oranges. The produce of this industry at Milan serves to supply the whole of Italy, and the rest is exported to the Tyrol and to the Canton Tessin, in Switzerland.

Boiler Explosions.—The engineer's monthly report, presented to the Manchester Association, on Tuesday, the 28th January, says that "during the month 149 visits of inspection have been made, and 314 boilers examined, while, in addition, 3 have been tested by hydraulic pressure. In the boilers examined 133 defects have been discovered, 5 of them being dangerous, thus:—Furnaces out of shape, 5; cases of fracture, 14; blistered plates, 9; internal corrosion, 14 (1 dangerous); external corrosion, 28 (4 dangerous); internal grooving, 2; external grooving, 6. Feed apparatus out of order, 1; water gauges ditto, 3; blow-out apparatus, ditto, 7; fusible plugs ditto, 1; safety-valves ditto, 6; pressure-gauges ditto, 10; while 1 boiler was found without any pressure-gauge, 5 without any blow-out apparatus, 20 without feed back pressure valves, and 1 case of over pressure was met with. The members, as a rule, afford the officers of the association increased facilities for making satisfactory examinations, by having the boilers better prepared, and the flues more thoroughly swept than heretofore, while a great facility is afforded for examining the plates of those boilers resting on mid-feather walls, where the members have complied with the request of the association to plough out the brick-work at the transverse seams of rivets. A considerable number of boilers recently enrolled have proved very defective in their construction, many of them being stayed at the flat end-plates with weak diagonal rods, and encumbered with vertical and transverse bolt stays, which are perfectly useless. It is recommended in all cases that substantial gussets should be adopted for staying the flat end-plates of boilers, whether of the Lancashire or Cornish type. Only one steam boiler explosion to report, which occurred to a boiler not under the inspection of the association. In addition to this, three minor explosions occurred, two of which resulted fatally, the other in personal injury. The principal explosion occurred at a colliery, at about mid-day, on Monday, January 13th. The boiler was of the plain, cylindrical, egg-ended, externally-fired class, and set with a flash flue, so that the flames from the furnace passed off direct to the chimney without making any return. It was plated longitudinally, and measured about 27 feet in length by 5 feet in diameter, and three-eighths of an inch in the thickness of plates, while it was fitted with two safety-valves, loaded to a pressure of 40 lbs. It was twenty years old, while it had been removed from another pit and set to work in its new position about three weeks before it exploded, part of the top having been replated about eighteen months before that. The front end of the boiler was thrown to a distance of about 35 yards, and the back end 90 yards, while the junction-valve and part of the steam pipe were found 84 yards from their original seating, one of the safety-valves 170 yards, and a ball belonging to one of the floats 180 yards. This ball, which weighed 50 lbs., had passed over a cottage in its course, and buried itself in the ground to a depth of three feet. A portion of one of the hemispherical ends fell on to a cottage, at a distance of about 40 yards from its original position, and smashed in the roof. In another cottage, about 14 yards from the boiler, the roof was riddled with bricks. It is an unpleasant fact that many dwellings are constantly in jeopardy from being within the range of bad boilers. An examination of the plates showed that they were excessively brittle. They broke without any bending, just like a glass bottle, and presented a coarse-grained bright crystalline fracture, instead of a grey fibrous one, while one of the plates was found to have rent for a length of about 4ft. just at the edge of a longitudinal seam of rivets, not from rivet-hole to rivet-hole, but through the solid plate at the line of caulking at the edge of the overlap. Also, the way in which the boiler was fed was trying to it, as the water was pumped in cold and led

down by means of an internal pipe to within a few inches of the bottom, nearly midway in its length, and about 2ft. from the spot at which the primary rent appeared to have started. After some conjectures as to the cause of the explosion, the report says:—"All such boilers as the one under consideration are treacherous and dangerous to a greater or less degree; more especially so when the plates are of a brittle character; and the cold feed injudiciously impinged directly on to the plates at the bottom of the shell, as in the present instance. If boilers of this type are retained in use at all, they should be truly cylindrical, and not plated lengthways but circumferentially, with the longitudinal seams breaking joint and not in line from one end of the boiler to the other, while the hemispherical ends should be firmly lashed to one another by longitudinal stays, and the plates and workmanship throughout of first-rate quality. Also the feed-water should be heated if possible, and instead of being allowed to impinge directly on to the plates, it should be dispersed on its introduction to the boiler by means of a horizontal feed-pipe, carried near to the surface of the water, and perforated all the way along with small holes. The safer plan, however, is to give up these externally-fired boilers altogether, and adopt the double furnace externally-fired Lancashire boiler instead. This course is now being adopted by several members of this association who are large colliery proprietors, and they find it to be attended both with economy and safety."

Steam Washing without Special Utensils.—The washing of linen is carried on in France in a much more scientific and systematic manner than is usual in England, but where sufficient care is not taken much injury is done to the linen, first by the beaters or wooden bats, and second by the excessive quantity of *eau de Javel* employed. The following is an account of an improved system of washing, recommended in a little work on domestic economy, called *La Fermière*, for rural establishments:—The articles to be washed being sorted and counted, each parcel is weighed, the strength of the lessive requiring to be regulated by the quantity, the condition, and the nature of the linen. The lessive is prepared in a back or tub at the side of the larger one in which the washing is to be performed; it consists of rectified soda at 80°, a kilogramme (2¼lbs.) to 100 litres (22½ gallons), quantity sufficient for one cwt. of linen. These proportions are suitable for fine articles not very dirty; for heavier and dirtier things about double the quantity of soda is recommended, and when mixed, the strength to be moderated accordingly. Generally, the strength of the soda is less than it possesses theoretically, so that the lessive is also rather weaker than it should be, a fault which may be remedied; while if the lessive, on the contrary, be too strong, the linen will be injured. The writer recommends the addition of from ten to sixteen ounces of soft soap to the lessive; the soap increasing the effect of the lessive and diminishing any injurious action. Care must be taken that the ingredients are thoroughly mixed. This lessive may be prepared with cold water, but hot is preferable. When the lessive is ready, the linen is dipped in piece by piece, withdrawn and slightly wrung, then placed in the large tub or back without being pressed down. The dirtiest pieces should be placed at the bottom. The bottom of the tub or back is to be pierced with holes of various sizes in the following manner; one, of two or three inches in diameter, in the centre; four similar ones around and equi-distant from it and the sides of the tub; and a number of other holes about an inch in diameter and four inches from each other, and very close to the sides of the tub. Against the sides of the tub and between the holes of the outer circle, are placed laths about two inches by one in thickness, and in each of the five large holes are placed smooth, round, wooden plugs, thicker above than below, and reaching somewhat higher than the top of the tub; the object of these laths and plugs is to form a number of chimneys for the steam. The linen is packed in between them, and when the tub is nearly full they are all withdrawn; the spaces thus left are covered over with the rest of the linen; large sheets are then laid over all and carefully tucked in around the edge, and a wooden or zinc cover placed over all. The fire being lighted, the steam in about four hours will have completely done its work, and will issue all round the cover. The fire is then put out, and in a few hours the lessive will all have drained off, when the linen may be rinsed out, and, if necessary, rubbed in the usual way. The inventor says that this system is very economical, as the steam causes the soda to combine with the greasy matters in the linen and form soap, as the potash of the lees does in the old system, but that it possesses the great advantage of carrying off the soap by drainage, whereas in the old plan it remained in the linen. Clothes treated in this manner are said to be easily washed out, and to become of remarkable whiteness.

Commerce.

The Rice Trade in France.—The consumption of Piedmontese rice has become very general in France. There was a considerable increase in the imports of rice in 1867, as will be seen in the following statements:—

1865.	Received. Kilogs.		Consumption in France. Kilogs.
Spain	21,715	.....	2,705
Italy	10,397,320	.....	8,186,755
British India	139,626	.....	139,586
Other countries	3,148	.....	61,592
Total kils.	10,561,809	.....	8,390,518

1866.	Received. Kilogs.		Consumption in France. Kilogs.
Spain	55,370	.....	820
Italy	13,230,941	.....	10,205,148
China	11,883	.....	—
Other countries	11,676	.....	14,798
Total kils.	13,309,870		10,220,766

1867.	Received. Kilogs.		Consumption in France. Kilogs.
England	162,446	.....	4,926
Italy	19,085,452	.....	13,188,340
Spain	1,251	.....	970
British India	203,993	.....	143
Other countries	21,858	.....	19,643
Total kils.	19,475,000		13,509,023

Thus out of the 19,475,000 kils. which were received there were consumed in France 13,509,023 kils., which is an immense increase on the imports of 1862, which did not amount to more than 7,292,900 kils. The increase in the consumption is supplied almost entirely from Northern Italy, and it tends to take the place of Indian rice. In 1861 the imports of rice from British India were 13,738,872 kils., against 13,533,723 kils. from Northern Italy. In 1866 the imports of rice from India did not exceed 6,784,099 kils., whilst those from Italy were 17,381,277 kils. Last year the imports of rice from Italy amounted to not less than 24,405,100 kils., whilst that imported from British India did not exceed 5,725,200 kils. The trade in rice between France and Italy has nearly doubled within the last five years, while the trade with India is but limited.

Progress of the Suez Canal.—During the first month and half of the present year most satisfactory progress has been made with the works of excavation for the Suez Canal. The position of these works up to the 15th February, 1868, was as follows:—

	C. metres.
Total amount excavated up to 31st December, 1867	33,955,535
Total amount excavated from 1st January to 15th February, 1868	2,599,834
Total amount remaining to be excavated	37,559,761
Total excavated in canal from Port Saïd to Suez (160 kilometres)	74,115,130

There is now every probability that these works will be completely terminated by the spring of next year. The piers at Port Saïd are likewise being pushed forward with great rapidity; on the 15th February there remained only 49,918 c. metres of artificial blocks out of the 250,000 c. metres to be immersed to complete the works. Towards the end of the present year the vast basins of Port Saïd will be thrown open to commerce. Upwards of 10,000 men are employed in this gigantic undertaking, and the steam power used is estimated at from 9 to 10,000 horse power.

The Manufacture of Butter and Cheese in Italy.—About one-half the produce of the cow, one quarter of that of the goat, and all the milk of the sheep, is used in Italy for making butter and cheese. The following is the annual average production of this important article of food:—

	Butter.	Cheese.	Amount.
	kils.	kils.	frs.
Lombardy	20,664,000	43,008,000	74,705,000
Venetia	1,456,000	6,216,000	9,270,000
Other Provinces	..	100,000,000	120,000,000
Total	22,120,000	149,224,000	209,975,000

There is no return of the exact quantity of butter made in other provinces. The best quality of butter is made in Lombardy, and an extensive exportation is carried on with the neighbouring countries; the next best is that of Parma, and then that made in some of the Venetian provinces and Piedmont. The total exports of butter amount to upwards of 500,000 francs yearly. The following are the exports and imports of this article from 1863 to 1865:—

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	kils.	frs.	kils.	frs.
1863	60,613	109,000	265,883	487,000
1864	73,740	133,000	430,734	775,000
1865	74,207	133,000	660,347	1,188,000
Average	69,520	125,000	452,305	817,000

The cheeses made in Italy are of various qualities, from cows', goats', and sheeps' milk, and it is needless to say that those made from cows' milk are the best. The cheese made in Lombardy is by far inferior to that made in other parts of Italy, and the best in Lombardy are made in the provinces of Pavia, Lodi, and Cremona, and are known in commerce by the name of "Parmesan cheeses." In Romagna, Piedmont, and Tuscany they have successfully produced the same quality of cheese. The milk of Modena and Parma is less rich than that of Lombardy, but cheeses have been made at some farms in those provinces which nearly equal those of Lombardy. Another excellent quality of cheese, called sbrintz, is also made, which resembles Swiss cheese in many respects. The cheeses of Naples and Sicily, called caciocavallo and incanestrato, are also well known. In many parts of Italy the production barely exceeds the consumption. The following are the exports and imports from 1862 to 1865:—

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	kils.	frs.	kils.	frs.
1862	4,170,936	6,965,000	1,371,452	2,290,000
1863	4,616,227	7,709,000	1,907,675	3,126,000
1864	5,046,852	8,428,000	3,488,871	5,827,000
1865	5,872,775	9,838,000	3,196,664	5,338,000
Average	4,926,697	8,235,000	2,491,165	4,145,000

The exports are of considerable importance, particularly in Lombardy, and although, as in all the provinces of Italy, a great deal of Swiss cheese is imported, they export a considerable amount of Parmesan in return, which is a source of considerable annual revenue. The Parmesan cheeses, or as they are better known in Italy under the name of formaggio di grana, are made at two different seasons, called sorti, one commencing in April and ending in September; the cheeses made at this period are called maggenga; and the others are called invernenga, or those made from September to April. The annual production of this kind of cheese is estimated at from 15 to 16 million kilogrammes. Of this amount about four and a-half millions of kilogrammes are made in the province of Milan, and the remainder in the provinces of Lodi, Pavia, Cremona, and Mantua. It may be remarked that this is exclusively manufactured where the land is irrigated. The other provinces, viz., Bergamo, Sondrio, and Brescia, also produce a considerable quantity, viz., from six to seven millions of kilogrammes annually of a somewhat similar quality. Butter forms also an important product, and is estimated at 15 millions of kilogrammes. Another quality of cheese, the stracchino, is a speciality of the provinces of Milan, Pavia, and Lodi. The great consumption of this quality of cheese is in the country itself, but there is also a good deal exported to England, France, Austria, Germany, and Russia. The Lombard butter is sent in great quantities to Tuscany, Romagna, the Marches, and Umbria. The quantity of cheese exported from Lombardy is from one million to 1,200,000 kilogrammes, and of butter from 200 to 300,000 kilogrammes. The value of these exports of cheese, butter, and stracchino, may be estimated at about three millions of francs.

Colonies.

The Tea Plant in Jamaica.—*The Kingston* (Jamaica) *Morning Journal* of March 26 says:—"The Government received by last packet, from the royal gardens at Kew, a case of healthy tea plants, which are to be sent to the Chinchona Nursery in St. Andrew, and placed under the care of Mr. Thompson, the island botanist. The idea has been formed, we believe, on good scientific authority, that our soil and climate are so well adapted that the tea plant will flourish here."

Cloth Manufacture in Victoria.—The first piece of cloth ever manufactured in this colony has been produced at the Geelong Woollen and Cloth Manufactory. After many difficulties, among which were the want of skilled men, and the breaking of a portion of the machinery, the company have at last got everything connected with the manufactory into almost perfect order, and are now ready to commence operations on a large scale. For some time past the various machines have been at work preparing the wool for the looms, and one of the latter was set in motion, and a piece of grey-coloured cloth, about eight yards in length, was turned out. Several gentlemen connected with the cloth trade in Melbourne paid a visit to the factory, besides some of

the townsmen of Geelong, interested in its products, and all expressed a good opinion of the appearance of everything, and the quality of the cloth in the loom.

Land Sales in South Australia.—The quantity of land sold by private auction and private contract in 1867 was 142,784 acres, and the amount received £163,700. The largest sale by auction occurred at Gambier, where 16,343 acres were sold for £18,246, exclusive of improvements. This was the only sale that took place out of Adelaide; and, on the following day, 2,703 acres that had passed the hammer were taken up, making a total of 19,046 acres sold in the district, for £20,949.

Gold From Victoria.—The falling off in the yield of the gold-fields has been attributed to a decrease in the number of miners, who have embarked in other pursuits. The returns of the number of miners employed throughout the year 1867 would seem to bear out this view. In 1865 the number of miners employed throughout the year was 83,214; in 1866, 73,577; and in 1867, 65,877, a reduction as between 1865 and 1867 of 17,357. The decrease has been alike regular amongst miners employed in alluvial and quartz workings. In 1865 the number of alluvial miners was 62,131; in 1866, 55,916; and in 1867, 51,719. The number of quartz miners in 1865 was 17,326; in 1866, 14,878; and in 1867, 14,138. In 1860 the average annual earnings per man were, in round numbers £79, 1861, £74; 1862, £67-£70; 1864, £74; 1865, £74; 1866, £80; 1867, £80. There has been a gradual diminution in the export of gold since 1862. During that year the quantity of Victoria gold shipped was 1,658,285 oz.; in 1863, 1,627,066 oz.; in 1864, 1,545,450 oz.; in 1865, 1,556,088 oz.; in 1866, 1,480,597 oz.; and in 1867, 1,392,336 oz.

Notes.

Horticultural Exhibition in France.—The Imperial Society of Horticulture is organising an international exhibition in connection with the fine art *salon*, which opens on the first of May. The horse show having closed, the lower floor of the Palais de l'Industrie is now free, and the whole of the central portion will be converted by the society into a garden, as upon former occasions. The flower show proper will extend from the first to the eighth of May inclusive, but a partial exhibition will be maintained throughout the whole duration of the *salon;* the sculpture, it is hoped, will be placed in the garden, as formerly; last year it was put under the galleries, in consequence of the occupation of the central portion by the commission of the Universal Exhibition, and was not seen to advantage. The Emperor, Empress, and Prince Imperial, the lady patronesses of the Horticultural Society, Marshal Vaillant, president of the society, and several other donors, give gold medals, and a considerable number of medals of various classes are offered by the society itself.

Excavations at Pompeii. — The impression of a papyrus, the letters of which are in a perfect state of preservation, has recently been found in the excavations at Pompeii. The importance of this discovery cannot be overlooked, as it is the first papyrus which has been found at Pompeii.

Discovery of the Remains of a Roman House.—The remains of a Roman house have been recently discovered in the neighbourhood of Volterra, at a short distance from the sea, and at the foot of the hill on which stood the ancient feudal castle of Castagneto, belonging to the Counts of Gherardesca. These remains, which were found at a short depth from the surface, consist of the "impluvium" and the pavement of four rooms in mosaic, in the Pompeian style. The design and colours are of extraordinary beauty, and in excellent preservation. The Government have sent some experienced men to continue the works of excavation, and for the purpose of preserving the objects which have been discovered.

Collection of American Paper Money.—Prince Napoleon, who, not long since, presented a very fine collection of gold Ottoman coins to the Bibliothèque Imperiale of Paris, has now given to the same establishment a collection of American bank-notes, consisting of seventy-five specimens of notes of various kinds, and twenty-five proofs on India paper of engraved portraits and vignettes employed in the ornamentation of these notes.

Value of Houses and Ground in Paris.—The official return of the purchase of houses for the alterations now proceeding in Paris, during the month of February, has recently been published. The number of houses contained in the returns is only 17, but the purchase money amounts to 3,627,180 francs (£135,087); the highest amount awarded for one house was 968,000 francs (£38,720). As regards ground, the highest rate awarded was 750 francs, or £30 per square metre, and the lowest 12frs. 20c., or 9s. 9d.; the total of the awards amounts to 1,739,608 francs, or £69,584.

Correspondence.

Liquid Fuel.—Sir, — The comprehensive paper of Mr. Paul clears away much vagueness on the subject of liquid fuel, but does not, I think, make out a case against the use of it, or the pursuit of further applications by better methods. Cost per ton may be an element, but it is far from the only element. The real question is, how much of the steam-making heat can we obtain for twenty shillings, after paying for all the incidental expenses,—labour in shipment, dirt and cleaning up, paying stokers, and shortening their lives by half-roasting them, melting out fire-bars, destroying boilers, hoisting, and lifting, and wasting by imperfect combustion, saying nothing of general discomfort by smoke. Whatever fuel we may use for the production of heat, our first process must be to convert it into gas, even in burning a tallow candle, therefore the fuel most easily convertible into gas must be, *cæteris paribus*, the best. Anthracite is the most difficult, and there runs a story in New York that an anthracite proprietor in Rhode Island, on applying to a learned professor for a certificate as to the durability of his fuel, received one to the effect that the professor verily believed "that it would be the last thing consumed at the day of judgment." Combustion can only take place by the admixture of a given quantity of carbon or hydrogen with a given quantity of oxygen or atmospheric air, and this admixture can only take place in the gaseous form. Mr. Wye Williams set this all forth very clearly some years ago, and Mr. Paul has done the same in a mode that he who runs may read. For many years we threw away the hydrogen of our coal by converting it into coke for our locomotives, and when we took to coal, smoke and all, we were surprised to find we made steam more easily. Nevertheless the reason is a plain one. We were using a flaming fuel instead of mere red coke. Many of us have tried to boil a kettle at a picnic, but all our art could not succeed in effecting successful contact between the red embers and the kettle, the rush of air between the two keeping the surfaces cool. But on the application of a sheet of newspaper or brown paper the heat immediately passed through the metal to the water, and the boiling was effected. So in the locomotive boiler, we call the whole contents of the fire-box and tubes "heating surface," when the real heating surface is in fact confined to that portion in actual contact with the hot coke; the surface above it, and the upper surface and tubes only get the contact of insufficiently heated air and gases, from which the heat does not sufficiently permeate the metal to get access to the water, and, for ought we know to the contrary, in the intervals of the cylinder blast, cold air may get access to the tubes through the chimney, with a cooling down effect. There is no doubt that flaming fuel is the best, for, rightly managed, it may cover the whole of the heating surface,

both firebox and tubes with lambent flame, and therefore liquid fuel which is capable of doing this, apart from other considerations, is preferable to bituminous coal, which cakes together, or anthracite, or coke, which gives out little or no flame. And Mr. Paul is quite right in theory in preferring air blast to chimney draught, so far as we know the comparative results, because in this case we can exactly measure out the quantities of gas and air, and the air draught of our furnaces have not yet obtained the exactitude of our paraffin lamps. But before we have done we shall bring our steam furnaces, locomotives and others, to the condition of a huge paraffin lamp. We know that we can adjust our table lamps exactly, so as to produce no smoke, the heated hood serving as a gas retort, and the numerous small holes disseminating the air in exact quantity to the gas produced. And the heat which escapes at the chimney, because we do not wish to utilize it, would be a powerful steam producer, according to its quantity of air brought in contact with heating surfaces. Even supposing that the cost of blowing air into the furnace instead of using chimney draught, were quite as great, there would be an advantage in its greater regularity and its easy adjustment, especially in locomotives which have to ascend and descend inclines. In the ordinary mode with coal we urge the fire down hill in order to get up a head of steam wherewith to mount the ascent. With liquid fuel, like a large lamp, and with capacity for consuming it exactly as we want it, we should adjust it by turning a cock just as we might require it. In lamps we draw up the liquid fuel by the capillary action of the wick. In furnaces we cannot use wicks, and therefore we must apply the liquid fuel in the form of spray, in order that it may be readily converted into gas by the heat of a fire at the onset, and afterwards by the saturated heat of the furnace. This spray is induced by the action of steam on the present process, the steam drawing with it a body of air in a similar mode to the plan of Mr. D. K. Clark for consuming smoke. What the quantity of steam may be, or what percentage of the boiler capacity, we do not know, or whether the same consumption of steam would work an air-blowing pump, but assuredly the steam is not fuel. It may urge a fire incidentally by forcing air in, but it will not kindle a fire, nor add to the amount of the combustible; but it will heat up the material to the gas-producing point, and therefore it deals with what is called "dead oil." Mr. Paul states that the total production of petroleum is only equivalent to 5 per cent. of the total amount of coal used for our steam navigation, and appears to think that it is only a limited quantity which may be obtained, because oil wells in America have, in some cases, ceased to flow—and, in others, have been exhausted—by pumping. Surely, the same thing has occurred with water wells, and coal pits also have been dug out; but we still possess water and coal. I do not believe in the exhaustive school of philosophy, either in coal or petroleum. On the contrary, I think that petroleum is of older growth than coal, and, for what we know, it is just as likely that coal may be a product of petroleum as well as of timber or peat moss. We have extracted coal for centuries; we have only sought for petroleum for three or four years; but there never was a period in the world's history that petroleum, in one form or other, was unknown, and it has continued to well up in various parts of the world without ceasing, notably in Trinidad. Gas, petroleum, shale, bitumen, appear to be its successive metamorphoses, and probably our chemists, when they try the synthetical process, will be enabled to produce coal from gas, as our companies, on the larger scale, produce gas from coal. The earlier companies, who dealt in portable gas, ere pipes were laid in the streets, condensed it into copper globes, and, if they condensed it too far, reduced it to oil—no doubt, petroleum. If that oil were taken, and evaporated to dryness, it would become bitumen, and the bitumen, under powerful hydraulic pressure, might possibly be crystallised into coal, and made very difficult of combustion. We, with our limited means, cannot "set the Thames on fire;" but Nature, with her unlimited means and her huge central furnace, may convert water, on a large scale, into its constituent gases, extract carbon from lime, and do many more things by operations we cannot supervise, but which we know we can imitate on a small scale. It matters but little to us how, or through how many ages, Nature has worked to realise this globe we live on; but we know that the whole physical business of the world is production, destruction, and reproduction; that nothing disappears in one form but it comes forth again in another. We have lost the dodo, but we have the duck still, and the elephant replaces the megatherium. The large animals grow fewer in number, but smaller races multiply. The serpent that stopped the army of Regulus in Africa is no more, and the sea serpent is problematic; but the Cachalot whale still bursts in ships' sides in his ire, with his huge head, and volcanoes break forth and disappear, and, if later speculators do not err, boil the ocean into the Gulf Stream, and render northern countries habitable by the human race; and coral islands grow, and land replaces water, and water replaces land, in one ceaseless change. In all this it is difficult to understand that Nature filled her coal-cellars for man's use with a limited supply, and no more, wherewith, in this our England, to pay off our national mortgages, and there an end. The probabilities are, that petroleum was the earliest fuel, left in hoard as it was made from the gases, and taking other and solider forms through the ages, and that the produce is ever going on, unfailing as the tides and winds, and as trees follow trees in changing varieties in the forests. And, no doubt, when we bore deep enough, we shall tap the under springs in England, as has been done elsewhere; and it would be no slight gain could we get our fuel by pumping, instead of delving by human hands hundreds of yards below the surface, away from the light of heaven, to the deterioration of our strong men. To return to timber or peat for our fuel would diminish largely the numbers of our population, and render less safe as a refuge this home of the world's freedom. So we shall go on in our progress, and take the materials from which trees and plants are eliminated at first instead of second-hand. It will be strange, indeed, if our progress in this be less rapid than it has been with the antecedent—coal. Not the less valuable is the counsel of Mr. Paul to keep us to exactitude in our facts. He may not be in possession of all the facts, and of positive knowledge as to the future; but he knows all that chemistry has taught up to the present time, and one important essential in progress is the exact knowledge of what can be done in conformity with existing principles. The existing principles may be set aside by something quite new. We may, by some process yet unknown, separate the oxygen from the atmosphere in the act of feeding the furnace, and so multiply our results manyfold, and we may yet discover how to make the most perfect fuel—*i.e.*, the most easily inflamed—perfectly safe till the moment required for its ignition, generating its power only at the moment and in the quantity needed. But progress points to the liquid in preference to the solid. It would be a very awkward thing to make a gas lamp for a table with a coal instead of an oil supply in the reservoir, though, do doubt, our mechanists could solve the problem, as Mr. Siemens has done in his gas furnaces.—I am, &c., W. BRIDGES ADAMS.

LIQUID FUEL.—SIR,—In my remarks on the above subject at the discussion of Mr. Paul's paper, on the 15th instant, I quoted Dr. Gesner as an authority for the quantity of oil produced from a ton of English coal, but, not having his work at hand, I could not give the exact particulars. Since the meeting I have referred to his work, and find the following given as the yield of the qualities of English coal named:—

1. Derbyshire.....	82	gals.	yield of crude oil per ton.
2. Wigan cannel coal	74	,,	
3. Liverpool	50	,,	
4. Poole (shale)	50	,,	
5. Newcastle	48	,,	
	5)304		

Mean of the five coals 60 gallons per ton.

Mr. Paul, in his reply, stated that Dr. Gesner, as an "authority, was not to be trusted;" and goes on to remark that "the very best specimens" of cannel coal "would yield about 60 gallons per ton," which, it will be seen, does not agree with the results of Dr. Gesner's practise. Now, as Mr. Paul did not inform us by what means he arrived at the results he describes, and as Dr. Gesner states that his results were obtained from actual working, or the use of tons of the coal specified, I, as a practical man, am far more disposed to believe that the results obtained by theoretical gentlemen with the aid of a teaspoon, a gas jet, and a blow-pipe, are more decidedly of a character "not to be trusted" than those obtained from actual working.—I am, &c., CHAS. F. YOUNG, C.E., Mem. Soc. Engineers' Assoc., I.N.A.

7, Duke-street, Adelphi, W.C., April 18, 1868.

MEETINGS FOR THE ENSUING WEEK.

MON.....R. Geographical, 8½. 1. Despatches and Letters from Dr. Livingstone. 2. Mr. F. Whymper, "Journey on the Yukon River, Northern Alaska."
R. United Service Inst., 8½. Major Leahy, R.E., "Army Organisation: Our Infantry Forces and Infantry Reserves." A discussion on this and Major Bevan-Edwards' paper, entitled "An Organisation for the Army of England," will be taken afterwards.
Actuaries, 7. Mr. M. N. Adler, "On Insurance Business in Germany."
Medical, 8.
Philosophical Club, 6.

TUES ...R. Medical and Chirurgical, 8½.
Civil Engineers, 8. Discussion upon the papers "On Irrigation in India and in Spain."
Royal Inst., 3. Dr. M. Foster, "On the Development of Animals."

WED ...Society of Arts, 8. Mr. Lobb, "On Progress in Oyster Culture."
London Inst., 12. Annual Meeting.
Zoological, 1. Annual Meeting.

THUR ...Royal, 8½.
Antiquaries, 8½.
R. Society Club, 6.
Royal Inst., 3. Prof. Odling, "On Chemical Combination."
Society of Fine Arts, 8. Lecture by Mr. William Burges.

FRI.....Geologists' Assoc., 8.
Philological, 8.
Royal Inst., 2. Annual Meeting.
Royal Inst., 8. Mr. F. T. Palgrave, "How to form Good Taste in Art."
Archæological Inst., 4.

SAT .....Royal Inst., 3. Prof. Odling, "On Chemical Combination."

Patents.

From Commissioners of Patents' Journal, April 17.

GRANTS OF PROVISIONAL PROTECTION.

Air, heated, applying to various purposes—1082—A. B. Walker.
Axles—1140—T. Faucheux.
Axles, &c., metal for—1091—H. B. Woodcock.
Bags, reticules, &c., material for manufacturing—612—R. Nicolls.
Bread, aërated, apparatus for manufacturing—1099—A. Scatchard.
Buildings, lighting and ventilating—1094—J. H. Weston.
Buildings, &c., heating—936—J. E. Lanc.
Camphor, refining 1124—C. D. Abel.
Cartridges—1107—G. Kynoch and W. Whitehill.
Cigars, &c.—946—J. G. Tatters, W. Keeble, and B. Newbery.
Coal tar, &c., utilising—176—E. Dorsett.
Commodes—1122—A. De Metz.
Cooking apparatus—1105—J. Norris and T. Quarm.
Cotton gins—1109—R. J. Morison.
Cotton seeds, cleaning—1142—F. A. E. G. de Massas.
Cramps, flooring, &c.—1106—J. Walker and J. Candlin.
Engines, &c., locomotive—766—J. B. Fell.
Fire-arms, breech-loading, and cartridges—968—R. G. Greenhow.
Fire-bars—1085—J. Jordan.
Furnaces for burning petroleum, &c.—1116—H. Lafone & J. Nicholas.
Grease, &c., utilising waste tarpaulin in the manufacture of—1126—J. McCulloch.
Iron and steel, &c.—1095—H. Bessemer.
Iron and steel, &c.—1130—J. H. Johnson.
Iron ore, preparing for smelting, &c.—910—W. E. Newton.
Iron, pig—1102—W. Smith.
Lamps—1134—J. G. Tongue.
Locks and latches—1144—R. Nabbs.
Matches, &c.—1086—W. Austin.
Motive-power, transmitting to potters' machinery—644—E. R. Walker.
Ores, &c., washing and separating—1146—G. Davies.
Pipe-joints—306—R. Wilson.
Propellers, screw—1089—J. Sinclair.
Pumps—1097—T. Couldrey, jun.
Railway carriages, fittings of—1087—F. Taylor.
Railway, moveable, for ordinary carriages—1113—E. Leahy.
Railway rails—768—H. Conybeare.
Sewing machines—1096—J. H. Johnson.
Tape measure cases—124—A. Cowling and W. Turner.
Telegraphs, electric—1132—G. Piggott.
Tobacco pipes—1136—H. C. Butcher.
Trousers, protecting from mud—1101—W. A. W. Sleigh and A. Pye.
Umbrellas, &c.—1114—T. Baker.
Velocipedes—1093—L. F. P. Rivière.
Ventilators, centrifugal—1104—G. Davies.

INVENTION WITH COMPLETE SPECIFICATION FILED.

Paper, &c., preparing or veneering—1212—S. W. Huntington.

PATENTS SEALED.

2892. M. Vogl and H. Van Dyk.
2894. T. H. Baker & T. Woodroffe.
2895. M. Samuelson.
2896. W. R. Lake.
2905. D. Pidgeon and W. Manwaring.
2908. M. Wilkin and J. Clark.
2914. L. Hamel.
2916. T. Bell and J. Richardson.
2918. J. Bannehr.
2920. W. Tredgold & J. McNeil.
2922. F. Prudencio, F. Cooper, and J. F. Cotterell.
2925. E. Casper.
2931. H. J. Bale.
2934. J. King.
2939. M. J. Matthews.
2941. W. R. Lake.
2943. L. Newton and J. Swailes.
2952. W. Crossley and T. C. Hutchinson.
2969. W. Beale.
3054. J. Maddocks.
3067. O. C. Evans.
3069. W. R. Lake.
3072. A. Chaplin.
3126. R. Leake and J. Beckett.
3180. C. B. Hodgetts.
3222. J. Morrison.
3285. T. H. Tilley.
3341. E. Townshend.
3570. W. Conisbee.
3685. J. Goodfellow.
397. J. A. Jones.
616. W. R. Lake.
647. A. V. Newton.
2923. H. W. Garrett and G. Holcroft.
2926. J. Hill and S. Shelley.
2948. M. W. Shove.
2949. R. Watkins.
2953. W. Barrett and C. Martin.
2956. J. Clapier.
2957. A. H. Brandon.
2958. C. Duncombe.
2960. W. R. Lake.
2961. J. Adams.
2976. T. Welton.
2994. S. Stackard.
3064. W. S. Dixon.
3122. W. E. Newton.
3665. S. and F. Lennard.
3715. C. G. Hill.
182. A. Bochkoltz.
540. W. Betts.

From Commissioners of Patents' Journal, April 21.

PATENTS SEALED.

2968. J. White.
2982. A. Chambers.
2986. R. W. Thomson.
2987. J. Ellison and J. Stirk.
2988. W. E. Gedge.
2990. J. Dodge.
2998. R. Weare.
3006. W. R. Lake.
3008. A. M. Clark.
3009. A. M. Clark.
3026. A. M. Clark.
3032. J. Young.
3035. J. Glover.
3038. W. Potts.
3047. W. Bishop and B. Burningham.
3051. G. Davies.
3063. W. Hall, J. Wren, and J. Brandwood.
3079. J. Gilmour.
3083. W. Darcey.
3148. J. F. Brinjes.
3152. T. Blackburn.
3153. C. Anderson.
3186. W. R. Lake.
3488. J. Rae and G. Miller.
3668. J. Lightfoot.
416. S. Read.
430. J. Howard and E. T. Bousfield.
438. W. T. Sugg.
610. J. Fordred, F. Lambe, and A. C. Sterry.
648. F. Lambe, A. C. Sterry, and J. Fordred.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

1068. W. Clark.
1071. A. Henry.
1084. T. Whitehead & N. Nussey.
1092. G. T. Bousfield.
1106. W. Robinson.
1108. J. Y. Betts.
1117. W. Scarratt and W. Dean.
1193. R. Ferrie, J. Murray, and A. Wilson.
1086. J. E. H. Andrew.
1102. F. A. Abel.
1103. W. Hale.
1107. H. Caudwell.
1123. C. Hall.
1244. E. G. Smith.

PATENT ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

980. R. A. Brooman.